



# PHYSICS

## BOOKS - DC PANDEY ENGLISH

### ATOMS

#### Example

1. In Rutherford's  $\alpha$  particle cexperiment with thin gold fail, 8100 scattered  $\alpha$ -particles per unit ara per unit area per minute were

observed at an angle of  $60^\circ$ . Find the number of scattered  $\alpha$  particles per unit area per minute at an angle of  $120^\circ$



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2. An alpha particle of energy 5 MeV is scattered through  $180^\circ$  by a fixed uranium nucleus. The distance of closest approach is of the order of



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3. Atomic number of silver metal is 47. calculate the speed at which a beam of protons has to be fired at a sheet of silver foil if the protons were able to approach to within  $2.5 \times 10^{-14}$  m of the silver nucleus?



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4. In Rutherford scattering experiment, what will be the correct angle for  $\alpha$  scattering for an impact parameter  $b = 0$ ?



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5. It is found experimentally that 13.6 eV energy is required to separate a hydrogen atom into a proton and an electron. Compute the orbital radius and the velocity of the electron in a hydrogen atom.



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6. Compute the angular momentum in 4th orbit, if  $L$  is the angular momentum of the

electron in the 2nd orbit of hydrogen atom.



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7. Using known values for hydrogen atom, calculate radius of third orbit for  $Li^+$



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8. Using known values for hydrogen atom, calculate speed of electron in fourth orbit of  $He^+$



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**9.** Find the ratio of product of velocity and time period of electron orbiting in 2nd and 3rd stable orbits.



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**10.** In the Bohr model of hydrogen atom, the electron is pictured to rotate in a circular orbit of radius  $5 \times 10^{-11}m$ , at a speed  $2.2 \times 10^6$

m/ s. What is the current associated with electron motion?



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**11.** In hydrogen atom, the electron is making  $6.6 \times 10^{15}$  rev/s around the nucleus in an orbit of radius  $0.528\text{\AA}$ . The magnetic moment ( $A - m^2$ ) will be



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**12.** The energy of the electron in the ground state of hydrogen atom is  $-13.6\text{eV}$ . Find the kinetic energy and potential energy of electron in this state.



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**13.** The total energy of electron in the ground state of hydrogen atom is  $-13.6\text{eV}$ . The kinetic energy of an electron in the first excited state is







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**14.** 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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**15.** if separation of two energy levels in an atom is  $2.3\text{eV}$ , when the frequency of

radiation emitted when the atom transits from the upper level to the lower level is



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**16.** 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 the first to the third Bohr orbit (ionization energy of the hydrogen atom equals 13.6 eV).



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17. 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 the first to the third Bohr orbit (ionization energy of the hydrogen atom equals 13.6 eV).



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18. A hydrogen like atom with atomic number  $Z$  is in an excited state of quantum number  $2n$ . It

can emit a maximum energy photon of 204 eV. If it makes a transition of quantum state  $n$ , a photon of energy 40.8 eV is emitted. Find  $n$ ,  $Z$  and the ground state energy (in eV) of this atom. Also calculate the minimum energy (in eV) that can be emitted by this atom during de-excitation. Ground state energy of hydrogen atom is  $-13.6$  eV.



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**19.** A moving hydrogen atom makes a head on collision with a stationary hydrogen atom. Before collision both atoms are in ground state and after collision they move together. What is the minimum value of the kinetic energy of the moving hydrogen atom, such that one of the atoms reaches one of the excited state?



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**20.** 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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21. 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 the first to the third Bohr orbit (ionization energy of the hydrogen atom equals 13.6 eV).



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**22.** Monochromatic radiation of wavelength  $\lambda$  are incident on a hydrogen sample in ground state. Hydrogen atoms absorb the light and subsequently emit radiations of 10 different wavelength . The value of  $\lambda$  is nearly :



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**23.** Ionization potential of hydrogen atom is  $13.6V$ . Hydrogen atoms in the ground state are excited by monochromatic radiation of



photon energy  $12.1\text{eV}$ . The spectral lines emitted by hydrogen atoms according to Bohr's theory will be



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**24.** An electron is moving in an orbit of a hydrogen atom from which there can be a maximum of six transition. An which there can be a maximum of three transition. Find ratio of the velocities of the electron in these two orbits.



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**25.** A  $12.5\text{eV}$  electron beam is used to excite a gaseous hydrogen atom at room temperature. Determine the wavelengths and the corresponding series of the lines emitted.



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**26.** In a hydrogen atom, a transition takes place from  $n = 3$  to  $n = 2$  orbit. Calculate the wavelength of the emitted photon. Will the

photon be visible ? To which spectral series will this photon belong? Given

$$R = 1.097 \times 10^7 m^{-1}$$



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**27.** What is the shortest wavelength present in the Paschen series of spectral lines?



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**28.** Find the longest and shortest wavelengths in the Lyman series for hydrogen. In what region of the electromagnetic spectrum does each series lie?



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**29.** If the series limit wavelength of the Lyman series for hydrogen atom is  $912\text{\AA}$ , then the series limit wavelength for the Balmer series for the hydrogen atom is





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**30.** Calculate (i) the wavelength and (ii) the frequency of the  $H_{\beta}$  line of the second line of Balmer series for some hydrogen.



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**31.** The wavelength of the first line of Lyman series for hydrogen is identical to that of the second line of Balmer series for some

hydrogen like ion Y. Calculate energies of the first three levels of Y.



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**32.** Hydrogen atom in its ground state is excited by means of monochromatic radiation of wavelength  $970.6\text{\AA}$ . How many lines are possible in the resulting emission spectrum ? Calculate the longest wavelength amongst them. You may assume that the ionisation energy for hydrogen atom is  $13.6\text{ eV}$ . Given

Planck's

constant

$$= 6.6 \times 10^{-34} Js, \quad c = 3 \times 10^8 ms^{-1}$$



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**33.** An electron of a hydrogen like atom is in excited, state. If total energy of the electron is -4.6 eV, then evaluate

(i) the kinetic energy and

(ii) the de-Broglie wavelength of the electron .



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**34.** The wavelength of light from the spectral emission line of sodium is 589 nm. Find the kinetic energy at which

(i) an electron, and

(ii) a neutron, would have the same de-Broglie wavelength .



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**35.** Let us assume that the de-Broglie wave associated with an electron forms a standing wave between the atoms arranged in a one-



dimensional array with nodes at each of the atomic sites. It is found that one such standing wave is formed, if the distance between the atoms of the array is  $3\text{\AA}$ . A similar standing wave is again formed, if  $d$  is increased to  $3.5\text{\AA}$  but not for any intermediate value of  $d$ . Find the energy of the electrons in electron volts and the least value of  $d$  for which the standing wave of the type described above can form.



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**36.** Hydrogen gas in the atomic state is excited to an energy level such that the electrostatic potential energy becomes  $-3.02\text{eV}$

Now, the photoelectric plate having  $W=4.6\text{ eV}$  is exposed to the emission spectra of this gas. Assuming all the transition of be possible, find the minimum de-Broglie wavelength of ejected photoelectrons.



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**37.** Find the cut off wavelength for the continuous X - rays coming from an X-ray tube operating at 40 kV.



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**38.** An X-ray tube is operated at 30 kV. If a particular electron loses 10% of its kinetic energy to emit an X-ray photon during the collision. Find the minimum wavelength and

maximum frequency associated with this photon.



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**39.** When the operating voltage in an -X-ray tube is increased to 3 times the original value, the shortest wavelength shifts by 25 nm. Find the original value of the operating voltage.



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**40.** The current flowing through the X-ray tube which is operating at 25 kV is 1 mA. Calculate the number of electrons hitting target per second . Also, find the energy falling on the target per second.



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**41.** The wavelength of  $K_{\alpha}$  X-ray for an element is 21.3 pm. It takes 11.3 ke V to knock out an electron from the L-shell of the atom of the

element. What should be the minimum accelerating voltage across on X-ray tube having the element as target which allows production of  $K_{\alpha}$  X-ray?



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**42.** The wavelength of  $K_{\alpha}$  line in copper is  $1.54\text{\AA}$ . The ionisation energy of  $K$  electron in copper in Joule is



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**43.** The wavelength of  $K_{\alpha}$  X-ray line for an element is  $0.42\text{\AA}$  . Find the wavelength of  $K_{\beta}$  line emitted by the same element.



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**44.** The energy of an element with a vacancy in K-shell is 35.2 keV, in L-shell is 5.25 keV and in M-shell is 0.55 keV higher than the energy of the atom of with no vacancy. Find the frequency of  $K_{\alpha}$ ,  $K_{\beta}$  and  $L_{\alpha}$  X-rays of that element.



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**45.** Use Moseley's law with  $b = 1$  to find the frequency of the  $K_{\alpha}$  X-ray of  $La(Z = 57)$  if the frequency of the  $K_{\alpha}$  X-ray of  $Cu(Z = 29)$  is known to be  $1.88 \times 10^{18}$  Hz.



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**46.** The  $k_{\alpha}$  X-rays of aluminium ( $Z = 13$ ) and zinc ( $Z = 30$ ) have wavelengths 887 pm and 146



pm respectively. Use Moseley's law

$\sqrt{\nu} = a(Z - b)$  to find the wavelength of the

$K_{\alpha}$  X-ray of iron ( $Z = 26$ ).



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## Check Point 12 1

1. The radius of the atom is of the order of

A.  $10^{-8}m$

B.  $10^{-9}m$

C.  $10^{-11}m$

D.  $10^{-10}m$

**Answer: D**



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

A. parabolic

B. spiral

C. circular

D. elliptical

**Answer: B**



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3. 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.  $v^2$

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

C.  $1/v^4$

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

**Answer: B**



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4. The number of  $\alpha$ -particles scattered per unit area  $N(\theta)$  at scattering angle  $\theta$  varies inversely as

A.  $\cos^4\left(\frac{\theta}{2}\right)$

B.  $\sin^4\left(\frac{\theta}{2}\right)$

C.  $\tan^4\left(\frac{\theta}{2}\right)$

D.  $\cot^4\left(\frac{\theta}{2}\right)$

**Answer: B**



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5. In Rutherford scattering experiment for scattering angle of  $180^\circ$ , what be the value of impact parameter?

A. 0

B.  $\infty$

C. 1

D. Data is insufficient

**Answer: A**



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6. The concept of stationary orbits was proposed by

A. Neil Bohr

B. J J Thomson

C. Rutherford

D. Issac Newton

**Answer: A**



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**7. In Bohr's atom model,**

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

B. electrons in a quanitsed orbit will not radiate energy

C. mass of electron remains constant

D. All the above conditions

**Answer: B**



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8. The angular momentum (L) of an electron moving in a stable orbit around nucleus is

A. half integral multiple of  $\frac{h}{2\pi}$

B. integral multiple of h

C. integral multiple of  $\frac{h}{2\pi}$

D. half integral multiple of h

**Answer: C**



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9. In Bohr's model, the atomic radius of the first orbit of Hydrogen atom is  $r_0$  then the radius of the third orbit is

A.  $r_0 / 9$

B.  $r_0$

C.  $9r_0$

D.  $3r_0$

**Answer: C**



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

A. Hydrogen atom

B. Deutrium atom

C. Singly ionised helium

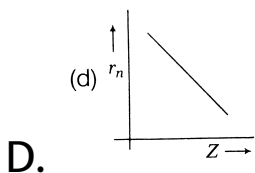
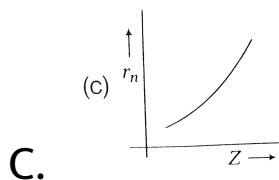
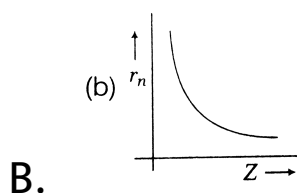
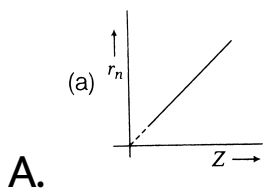
D. Doubly ionised lithium

**Answer: D**



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11. Radius ( $r_n$ ) of electron in  $n$ th orbit versus atomic number ( $Z$ ) graph is



**Answer: B**



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

A.  $1/2$

B.  $\frac{2}{137}$

C.  $1/137$

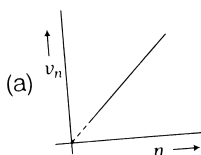
D.  $1/237$

**Answer: C**

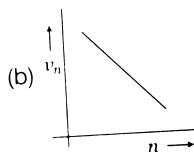


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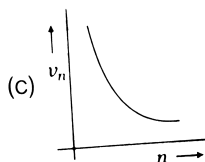
13. Speed ( $V_n$ ) of electron in  $n$ th orbit versus principal quantum number ( $n$ ) graphs is



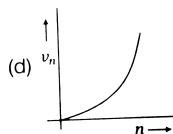
A.



B.



C.



D.

**Answer: B**



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**14.** The orbital frequency of an electron in the hydrogen atom is proportional to

A.  $n^3$

B.  $n^{-3}$

C.  $n$

D.  $n^0$

**Answer: D**



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## Check Point 12 2

1. Product of velocity and time period of electron orbiting in  $n$ th stable orbit is proportional to

A.  $n^3$

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



C.  $n$

D.  $n^2$

**Answer: D**



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2. Kinetic energy of electron in  $n$ th orbit is given by

A.  $\frac{Rhc}{2n^2}$

B.  $\frac{2Rhc}{n}$

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

D.  $\frac{Rhc}{n^2}$

**Answer: D**



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3. The energy of the electron in the ground state of hydrogen atom is  $-13.6\text{eV}$ . Find the kinetic energy of electron in this state.

A. 1.85 eV

B. 13.6 eV

C. 6.8 eV

D. 3.4 eV

**Answer: B**



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**4.** Potential energy ( $PE_n$ ) and kinetic energy ( $KE_n$ ) of electron in  $n$ th orbit are related as

A.  $PE_n = KE_n$

B.  $PE_n = -2KE_n$

C.  $PE_n = 2KE_n$

D.  $PE_n = KE_n$

**Answer: B**



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5. The ground state energy of hydrogen atom is  $-13.6\text{eV}$ . What is the potential energy of the electron in this state

A. 0 eV

B. -27.2 eV

C. 1 eV

D. 2 eV

**Answer: B**



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**6.** In the  $n$ th orbit, the energy of an electron

$E_n = -\frac{13.6}{n^2} eV$  for hydrogen atom. The

energy required to take the electron from first orbit to second orbit will be

A.  $10.2eV$

B.  $12.1eV$

C.  $13.6eV$

D.  $3.4eV$

**Answer: A**



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

A.  $13.2E$

B.  $7.2E$

C.  $5.6E$

D.  $3.2E$

**Answer: B**



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8. Ionisation potential (IP) and ionisation (IE) are related a

A.  $IP = (IE)e$

B.  $IP = \frac{IE}{e}$

C.  $IE = \frac{IP}{e^2}$

D.  $IP = \frac{IE}{e^2}$

**Answer: B**



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

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

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

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

**Answer: B**



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10. Which one of the series of hydrogen spectrum is in the visible region ?

A. Lyman series

B. Balmer series

C. Paschen series

D. Brackett series

**Answer: B**



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11. In which of the following system will the wavelength corresponding to  $n = 2 \rightarrow n = 1$  be minimum ?

- A. Hydrogen atom
- B. Deutrium atom
- C. Singly ionised helium
- D. Doubly ionised lithium

**Answer: D**



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12. 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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**13.** In which of the following transition will the wavelength be minimum ?

A.  $n=5$  to  $n=4$

B.  $n=4$  to  $n=3$

C.  $n=3$  to  $n=2$

D.  $n=2$  to  $n=1$

**Answer: D**



14. Wavelength corresponding to series limit is

A.  $\frac{1}{\lambda} = \frac{2R}{n}$

B.  $\frac{1}{\lambda} = \frac{R^2}{n^2}$

C.  $\frac{1}{\lambda} = \frac{R^2}{n^2}$

D.  $\frac{1}{\lambda} = \frac{R}{n}$

**Answer: C**



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15. For the Bohr's first orbit of circumference  $2\pi r$ , the de - Broglie wavelength of revolving electron will be

A.  $2\pi r$

B.  $\pi r$

C.  $\frac{1}{2\pi r}$

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

**Answer: A**



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**16.** Which of the following is incorrect regarding limitations of Bohr's model?

A. This model is applicable only to single electron atom

B. It does not explain fine structure of spectral lines

C. It's assumption regarding stationary orbits supports Heisenberg uncertainty principle



D. None of the above

**Answer: C**



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## Check Point 12 3

**1. X-rays were discovered by**

A. Becquerel

B. Roentgen

C. Marrie Curie

D. Von Laue

**Answer: B**



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2. Which of the following wavelength falls in X - ray region

A.  $10000\text{\AA}$

B.  $1000\text{\AA}$

C.  $1\text{\AA}$

D.  $10^{-2}\text{\AA}$

**Answer: C**



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**3. X-rays are in nature similar to**

A. beta rays

B. gamma rays

C. de-Broglie rays

D. cathode rays

**Answer: B**



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**4. The nature of X-rays spectrum is**

A. continuous

B. line

C. continuous and line

D. None of these

**Answer: C**



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5. The kinetic energy of electrons that strike the target is increased , then the cut-off wavelength of continuous X-rays spectrum

A. increases

B. decreases

C. no change

D. cannot be said

**Answer: B**



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6. If  $V$  be the accelerating voltage, then the maximum frequency of continuous X-rays is given by

A.  $\frac{eh}{V}$

B.  $\frac{hV}{e}$

C.  $\frac{eV}{h}$

D.  $\frac{h}{eV}$

**Answer: C**



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7. An X-ray tube is operated at 50 kV. The minimum wavelength produced is

A.  $0.5\text{\AA}$

B.  $0.5\text{\AA}$

C.  $0.25\text{\AA}$

D.  $1\text{\AA}$

**Answer: C**



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8. X-rays are being produced in a tube operating at  $10^5 V$ . The velocity of X-rays produced is

A.  $3 \times 10^8 ms^{-1}$

B.  $2.8 \times 10^8 ms^{-1}$

C.  $3.1 \times 10^8 ms^{-1}$

D.  $3 \times 10^{10} ms^{-1}$



**Answer: A**



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9. The energy of a photon of characteristic X-ray from a Coolidge tube comes from

A. the kinetic energy of the striking electron

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

C. the kinetic energy of the ions of the target

D. an atomic transition in the target

**Answer: D**



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**10.** In X-rays spectrum, transition of an electron from an outer shell to an inner shell gives a characteristics X-rays spectral line. If

we consider the spectrum line

$K_\beta$ ,  $L_\beta$  and  $M_\alpha$ , then

- A.  $K_\beta$  and  $L_\beta$  have a common inner shell
- B.  $K_\beta$  and  $L_\beta$  have a common outer shell
- C.  $L_\beta$  and  $M_\alpha$  have a common outer shell
- D.  $L_\beta$  and  $M_\alpha$  have a common inner shell

**Answer: C**



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11. In X-ray spectrum wavelength  $\lambda$  of line  $K_{\alpha}$  depends on atomic number  $Z$  as

A.  $\lambda \propto Z^2$

B.  $\lambda \propto (Z - 1)^2$

C.  $\lambda \propto \frac{1}{(Z - 1)}$

D.  $\lambda \propto \frac{1}{(Z - 1)^2}$

**Answer: D**



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12. For characteristic  $X$  - ray of some material

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

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

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

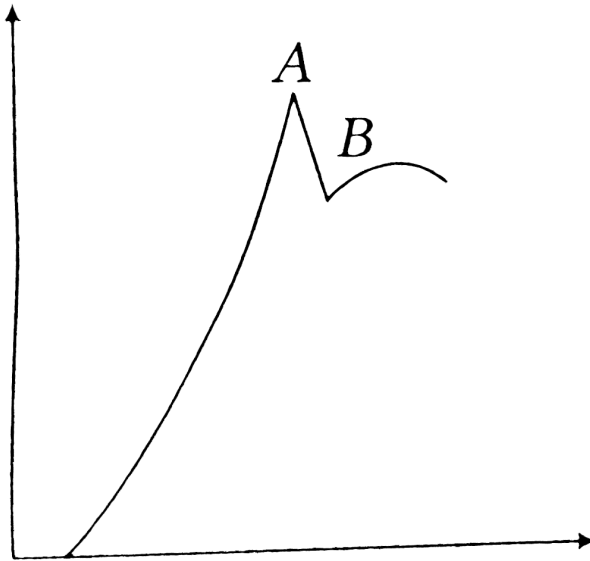
D.  $\lambda(M_\alpha) < \lambda(L_\alpha) < \lambda(K_\alpha)$

**Answer: C**



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13. Sharp peak point A represents



A. characteristic X-rays

B. continuous X-rays

C. Bremsstrahlung

D. discontinuous spectrum

**Answer: A**



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**14.** Mosley's law relates the frequencies of line X-rays with the following characteristics of the target element

- A. its density
- B. its atomic weight
- C. its atomic number
- D. interplaner spacing of the atomic planes

**Answer: C**



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**15. Bragg's law for X-rays is**

A.  $d \sin \theta = 2n\lambda$

B.  $2d \sin \theta = n\lambda$

C.  $n \sin \theta = 2\lambda d$

D. None of these

**Answer: B**





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## Taking It Together

1. Increase in which of the following increases the penetrating power of the X-rays ?

A. velocity

B. intensity

C. frequency

D. wavelength

**Answer: C**



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2. *X*-rays are not used for radar purposes, because they are not,

- A. they are not reflected by the target
- B. they are not electromagnetic waves
- C. they are completely absorbed by the air
- D. they sometimes damage the target

**Answer: A**



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**3. The X- rays beam coming from an X- rays tube will be**

**A. monochromatic**

**B. having all wavelength larger than a certain minimum wavelength**

C. having all wavelengths smaller than a certain maximum wavelength

D. having all wavelength between a minimum and a maximum wavelength

**Answer: D**



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

A. the kinetic energy of the striking electron

B. the kinetic energy of the free electrons 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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5. 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 apart

C. it has a very small mass

D. it has a single electron

**Answer: A**



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6. Moseley's law for characteristic X-rays is

$$\sqrt{\nu} = a(Z - b). \text{ In this,}$$

A. Both  $a$  and  $b$  are independent of the material

B.  $a$  is independent but  $b$  depends on the material

C.  $b$  is independent but  $a$  depends on the material

D. Both  $a$  and  $b$  depends on the meterial

**Answer: A**



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**7. A set of atoms 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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**8. X-ray beam can be deflected**

A. magnetic field

B. electric field

C. Both (a) and (b)

D. None of these

**Answer: D**



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9. In an  $X$  - rays tube , the intensity of the emitted  $X$  - rays beam is increased by

A. increasing the filament current

B. decreasing the filament current

C. increasing the target potential

D. decreasing the target potential

**Answer: A**



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**10.** If the current in the circuit for heating the filament is increased, the cutoff wavelength

A. will increase

B. will decrease

C. will remain unchanged

D. may increase or decrease

**Answer: C**



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**11. X-rays are produced by jumping of:**

A. electrons from lower to higher energy  
orbit of atom

B. electrons from higher to lower energy

orbit of atom

C. protons from lower to higher energy

orbit of nucleus

D. protons from higher to lower energy

orbit of nucleus

**Answer: B**



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12. The difference in angular momentum associated with electron in two successive orbits of hydrogen atom is:

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

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

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

D.  $(n - 1) \frac{h}{2\pi}$

**Answer: B**



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**13.** Choose the incorrect statement regarding the Bohr model of the hydrogen atom

A. The radius of  $n$ th orbit is proportional to

$$n^2$$

B. The total energy of electron in  $n$ th orbit  
is proportional to  $n$

C. The angular momentum of an electron  
in an orbit is an integral multiple of

$$h / 2\pi$$

D. The magnitude of the potential energy of an electron in any orbit is greater than its kinetic energy

**Answer: B**



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**14.** 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 electrons

C. Energy of the atom

D. Orbital angular momentum of the  
electron

**Answer: D**



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15. The second line in Paschen series is obtained when the electron makes transition from

- A. fourth orbit to third orbit
- B. seventh orbit to third orbit
- C. six orbit to third orbit
- D. fifth orbit to third orbit

**Answer: D**



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**16.** An electron moves in a circular orbit at a distance from a proton with kinetic energy,  $E$ , to escape to infinity, the minimum energy which must be supplied to the electron is

A.  $E$

B.  $2E$

C.  $0.5E$

D.  $E\sqrt{2}$

**Answer: A**



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17. Molybdenum is used as a target element for production of  $X$  - rays because it is

A. light and can easily deflect electrons

B. light can absorb electrons

C. a heavy element with a high melting point

D. an element having high thermal conductivity

**Answer: D**



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**18.** An X-ray has a wavelength of  $0.010 \text{ \AA}$ . Its momentum is

A.  $2.126 \times 10^{-23} \text{ kgms}^{-1}$

B.  $6.626 \times 10^{-22} \text{ kgms}^{-1}$

C.  $3.456 \times 10^{-25} \text{ kgms}^{-1}$

D.  $3.313 \times 10^{-22} \text{ kgms}^{-1}$

**Answer: B**



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**19.** X-rays of  $\lambda = 1\text{\AA}$  have frequency

A.  $3 \times 10^8 \text{ Hz}$

B.  $3 \times 10^{18} \text{ Hz}$

C.  $3 \times 10^{10} \text{ Hz}$

D.  $3 \times 10^{15} \text{ Hz}$

**Answer: B**



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**20.** The simple Bohr model cannot be directly applied 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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21. The velocity of an electron in the first orbit of  $H$  atom is  $v$ . The velocity of an electron in the 2nd orbit of  $He^+$  atom.



A.  $2v$

B.  $v$

C.  $v/2$

D.  $v/4$

**Answer: B**



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**22.** A X-ray tube operates at an accelerating potential of 20 kV. Which of the following

wavelength will be absent in the continuous spectrum of X-rays ?

A. 12 pm

B. 75 pm

C. 65 pm

D. 95 pm

**Answer: A**



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**23.** A metal block is exposed to beams of X-rays of different wavelength. X-rays of which wavelength penetrate most

A.  $2\text{\AA}$

B.  $4\text{\AA}$

C.  $6\text{\AA}$

D.  $8\text{\AA}$

**Answer: A**



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24.  $O_2$  molecule consists of two oxygen atoms.

In the molecule, nuclear force between the nuclei of the two atoms

A. is not important because nuclear forces are short-ranged

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

C. cancels the repulsive electrostatic force between the nuclei

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

**Answer: A**



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**25.** The patient is asked to drink  $BaSO_4$  for  
examining the stomach by X-rays because X-  
rays are-

- A. reflected by heavy atoms
- B. refracted by heavy atoms
- C. less absorbed by heavy atoms
- D. more absorbed by heavy atoms

**Answer: D**



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**26.** The orbital angular momentum of electron in the  $n_1$ th shell of element of atomic number  $Z_1$  is  $L_1$  and the same in the  $n_2$ th shell of

element of atomic number  $Z_2$  is  $L_2$  If  $L_2 > L_1$

then

A.  $n_2 > n_1$

B.  $Z_2 > Z_1$

C.  $n_2 Z_2 > n_1 Z_1$

D. Both (a) and (b)

**Answer: A**



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27. For production of characteristic

$K_{\beta}X$  – rays, the electron transition is

A.  $n=2$  to  $n=1$

B.  $n=3$  to  $n=2$

C.  $n=3$  to  $n=1$

D.  $n=4$  to  $n=2$

**Answer: C**



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28. Hydrogen atom is excited from ground state to another state with principal quantum number equal to 4. Then the number of spectral lines in the emission spectra will be

A. 2

B. 3

C. 5

D. 6

**Answer: D**



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**29.** Consider the following two statements A and B and identify the correct choice in the given answer

A : The characteristic X-ray spectrum depends on the nature of the material of the target

B : The short wavelength limit of continuous X-ray spectrum varies inversely with the potential difference applied to the X-rays tube

A. A is true and B is false

B. A is false and B are true

C. Both A and B are true

D. Both A and B are false

**Answer: C**



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**30.** In a hypothetical Bohr hydrogen, the mass of the electron is doubled. The energy  $E_0$  and the radius  $r_0$  of the first orbit will be ( $a_0$  is the Bohr radius)

A.  $E_0 = -27. eV, r_0 = a_0 / 2$

B.  $E_0 = -27.2eV, r_0 = a_0 = a_0$

C.  $E_0 = -13.6eV, r_0 = a_0 / 2$

D.  $E_0 = -13.6eV r_0 = a_0$

**Answer: A**



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**31.** Ionization energy of a hydrogen-like ion A is greater than that of another hydrogen like ion B . Let  $r$ ,  $u$ ,  $E$  and  $L$  represent the radius of the

orbit , speed of the electron , total energy of the electron and angular momentum of the electron respectively (for the same  $n$  ). 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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32. If  $\omega$  the angular speed of electron in the  $n$ th orbit hydrogen atom, then

A.  $\omega \propto n^{1/2}$

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

C.  $\omega \propto \frac{1}{n^2}$

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

**Answer: D**



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33. Hydrogen atom emits blue light when it changes from  $n = 4$  energy level to the  $n = 2$  level. Which colour of light would the atom emit when it changes from the  $n = 5$  level to the  $n = 2$  level ?

A. Red

B. Yellow

C. Green

D. Violet

**Answer: D**



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**34.** The potential difference between the cathode and the target electrode in a Coolidge tube is 24.75 kV. The minimum wavelength of the emitted X-rays is

A.  $0.1\text{\AA}$

B.  $0.5\text{\AA}$

C.  $1\text{\AA}$

D.  $5\text{\AA}$



**Answer: B**



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**35.** In Rutherford scattering experiment, what will be the ratio of impact parameter for scattering angles  $\theta_1 = 90^\circ$  and  $\theta_2 = 120^\circ$

A. 1

B.  $\sqrt{2}$

C. 2

D.  $\sqrt{3}$

**Answer: D**



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

A. 53pm

B. 27 pm

C. 18 pm

D. 13 pm

**Answer: C**



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

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

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

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

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

**Answer: C**



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**38.** When an electron in hydrogen atom is excited, from its 4th to 5th stationary orbit, the change in angular momentum of electron is (Planck's constant:  $h = 6.6 \times 10^{-34} J - s$ )

A.  $4.16 \times 10^{-34} J - s$

B.  $3.32 \times 10^{-34} J - s$

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

D. None of these

**Answer: C**



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**39.** The magnetic moment ( $\mu$ ) of a revolving electron around the nucleus varies with principle quantum number  $n$  as

A.  $\mu \propto n$

B.  $\mu \propto 1/n$

C.  $\mu \propto n^2$

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

**Answer: A**



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**40.** The electron in a hydrogen atom makes a transition from  $n = n_1$  to  $n = n_2$  state. The time period of the electron in the initial state

$(n_1)$  is eight times that in the final state  $(n_2)$ .

The possible values of  $n_1$  and  $n_2$  are

A.  $n_1 = 8, n_2 = 1$

B.  $n_1 = 4, n_2 = 2$

C.  $n_1 = 2, n_2 = 4$

D.  $n_1 = 1, n_2 = 8$

**Answer: B**



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**41.** Two elements A and B with atomic numbers  $Z_A$  and  $Z_B$  are used to produce characteristic X-rays with frequencies  $\nu_A$  and  $\nu_B$  respectively. If  $Z_A : Z_B = 1 : 2$ , then  $\nu_A : \nu_B$  will be

A.  $1 : \sqrt{2}$

B.  $1 : 8$

C.  $4 : 1$

D.  $1 : 4$

**Answer: B**



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42. An electron revolves round a nucleus of charge  $Ze$ . In order to excite the electron from the  $n = 20$  to  $n = 3$ , the energy required is  $47.2eV$ .  $Z$  is equal to

A. 3

B. 4

C. 5

D. 2

**Answer: C**



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**43.** As per the Bohr model, the minimum energy (in eV) required to remove an electron from ground state of doubly ionized Li atom ( $Z = 3$ ) is

A. 1.51

B. 13.6

C. 40.8

D. 122.4

**Answer: D**



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

A. 54.4 eV

B. 13.6 eV

C. 40.8 eV

D. 27.2 eV

**Answer: A**



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**45.** 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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**46.** An electron makes a transition from orbit  $n = 4$  to the orbit  $n = 2$  of a hydrogen atom.

The wave number of the emitted radiations ( $R =$  Rydberg's constant) will be

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

B.  $\frac{2R}{16}$

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

D.  $\frac{4R}{16}$

**Answer: C**



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47. The  $K_{\alpha}$  and  $K_{\beta}$  lines of characteristic X-ray spectrum of molybdenum are  $0.76\text{\AA}$  and  $0.64\text{\AA}$ , respectively. The wavelength of  $L_{\alpha}$  line is

A.  $1.4\text{\AA}$

B.  $2.4\text{\AA}$

C.  $4.1\text{\AA}$

D.  $3.6\text{\AA}$

**Answer: C**



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**48.** The longest wavelength that can be analysed by a sodium chloride crystal of spacing  $d = 2.82\text{\AA}$  in the second order is -

A.  $2.82\text{\AA}$

B.  $5.64\text{\AA}$

C.  $8.46\text{\AA}$

D.  $11.28\text{\AA}$



**Answer: A**



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**49.** The wavelengths of  $K_{\alpha}$  X-rays from lead isotopes  $Pb^{204}$ ,  $Pb^{206}$  and  $Pb^{208}$  are  $\lambda_1$ ,  $\lambda_2$  and  $\lambda_3$  respectively. Choose the correct alternative.

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

B.  $\lambda_1 > \lambda_2 > \lambda_3$

C.  $\lambda_1 < \lambda_2 < \lambda_3$

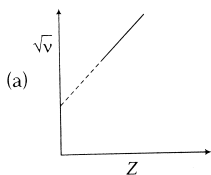
$$\text{D. } \lambda_2 = \sqrt{\lambda_1 \lambda_3}$$

**Answer: D**



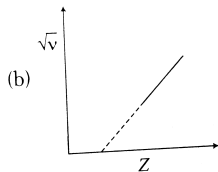
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**50.** The graph between the square root of the frequency of a specific line of characteristic spectrum of  $X$  - rays and the atomic number of the target will be

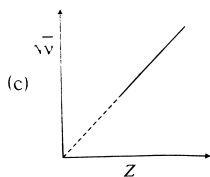


**A.**

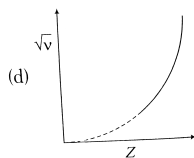
B.



C.



D.



**Answer: B**



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**51.** The ratio between acceleration of the electron in singly ionized helium atom and

doubly ionized lithium atom (both in ground state) is  $(x/27)$ . Find value of  $x$ .

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

B.  $\frac{27}{8}$

C.  $\frac{8}{27}$

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

**Answer: C**



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52. Magnetic moment of an electron in  $n$ th orbit of hydrogen atom is

A.  $\frac{neh}{\pi m}$

B.  $\frac{neh}{4\pi m}$

C.  $\frac{meh}{2\pi m}$

D.  $\frac{neh}{4\pi n}$

**Answer: B**



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53. A sphere of work function  $\phi = 4.6\text{eV}$  is suspended in a vacuum number by an insulating thread. Radiation of wavelength  $\lambda = 0.2\mu\text{m}$  strikes on the sphere. The maximum electric potential of the sphere will be

A. 4.6 V

B. 6.2 V

C. 1.6 V

D. 3.2 V

**Answer: A**



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**54.** The wavelength of radiation emitted is  $\lambda_0$  when an electron jumps from the third to second orbit of hydrogen atom. For the electron jumping from the fourth to the second orbit of the hydrogen atom, the wavelength of radiation emitted will be

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

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

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

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

**Answer: B**



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**55.** Hard X-ray for the study of fractures in bones should have a minimum wavelength of  $10^{-11}$  m. the accelerating voltage for electrons in X-ray machine should be



A.  $< 124.2\text{keV}$

B.  $> 124.2\text{keV}$

C. Between 60 keV and 70 keV

D. equal to 100 keVs

**Answer: A**



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**56.** An electron with kinetic energy  $5\text{eV}$  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 completely inelastic

**Answer: A**



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**57.** An electron makes a transition from orbit  $n=4$  to the orbit  $n=2$  of a hydrogen atom. The

wave number of the emitted radiations

( $R$ =Rydberg's constant) will be

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

B.  $\frac{16}{5R}$

C.  $\frac{5R}{16}$

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

**Answer: A**



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**58.** The minimum energy to ionize an atom is the energy required to

A. add on electron to the gaseous state of atom

B. excite the atom from its ground state to its first excited state

C. remove one outermost electron from the gaseous state of atom

D. remove one innermost electron from the gaseous state of atom

**Answer: C**



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**59.** Let  $v_1$  be the frequency of the series limit of the Lyman series,  $v_2$  be the frequency of the first line of the Lyman series, and  $v_3$  be the frequency of the series limit of the Balmer series. Then

A.  $v_1 - v_2 = v_3$

B.  $v_1 = v_2 - v_3$

C.  $\frac{1}{v_2} = \frac{1}{v_1} = \frac{1}{v_3}$

D.  $\frac{1}{v_1} = \frac{1}{v_2} + \frac{1}{v_3}$

**Answer: A**



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**60.** 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. 3

B. 4

C. 5

D. 2

**Answer: D**



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61. When an  $\alpha$ -particle of mass  $m$  moving with velocity  $v$  bombards on heavy nucleus of charge  $Ze$ , its distance of closest approach from the nucleus depends on  $m$  as

A.  $\frac{Qq}{4\pi\epsilon_0 m^2}$

B.  $\frac{Qq}{2\pi\epsilon_0 m v^2}$

C.  $\frac{Qq m v^2}{2}$

D.  $\frac{Qq}{m v^2}$

**Answer: B**



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62. The energy of an electron in excited hydrogen atom is  $-3.4 \text{ eV}$ . Then, according to Bohr's theory, the angular momentum of the electron of the electron is

A.  $2.1 \times 10^{-34} \text{ J} \cdot \text{s}$

B.  $3 \times 10^{-34} \text{ J} \cdot \text{s}$

C.  $2 \times 10^{-34} \text{ J} \cdot \text{s}$

D.  $0.5 \times 10^{-34} \text{ J} \cdot \text{s}$

**Answer: A**



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**63.** The shortest wavelength which can be obtained in hydrogen spectrum ( $R = 10^7 m^{-1}$ )

A.  $1000 \text{ \AA}$

B.  $8000 \text{ \AA}$

C.  $1300 \text{ \AA}$

D.  $2100 \text{ \AA}$

**Answer: A**



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**64.** The wavelength of the first spectral line of sodium is  $5896 \text{ \AA}$ . The first excitation potential of sodium atom will be (Planck's constant  $h = 6.63 \times 10^{-34} \text{ J-s}$ )

A.  $4.2V$

B.  $3.5V$

C.  $2.1V$

D. None of these

**Answer: C**



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**65.** The shortest wavelength in Lyman series is 91.2 nm. The longest wavelength of the series is

A. 121.6 nm

B. 182.4 nm

C. 243.4 nm

D. 364.8 nm

**Answer: A**



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**66.** Energy of 24.6 eV is required to remove one of the electron from a neutral helium atom. The energy (in eV) required to remove both electrons from a neutral helium atom is

A. 38.2

B. 49.2

C. 51.8

D. 78.6

**Answer: D**



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**67.** If the radius of first Bohr's orbit is  $x$ , then de-Broglie wavelength of electron in 3rd orbit is nearly  $(n\pi x)$  Find value of  $n$

A.  $2\pi r$

B.  $6\pi r$

C.  $9x$

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

**Answer: B**



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**68.** An excited hydrogen atom emits a photon of wavelength  $\lambda$  in returning to the ground

state. If 'R' is the Rydberg's constant, then the quantum number 'n' of the excited state is:

A.  $\sqrt{\lambda R(\lambda R - 1)}$

B.  $\sqrt{\frac{\lambda R}{(\lambda R - 1)}}$

C.  $\sqrt{\frac{(\lambda R - 1)}{\lambda R}}$

D.  $\sqrt{\frac{1}{\lambda R(\lambda R - 1)}}$

**Answer: B**



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69. An alpha nucleus of energy  $\frac{1}{2}mv^2$  bombards a heavy nuclear target of charge  $Ze$ . Then the distance of closest approach for the alpha nucleus will be proportional to

A.  $1/m$

B.  $1/v^2$

C.  $1/ze$

D.  $v^2$

**Answer: A**



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70. if the frequency of  $K_a$  X-ray emitted from the element with atomic number 31 is  $f$ , then the frequency of  $K_a$  x-ray emitted from the element with atomic number 51 would be

A.  $\frac{5f}{3}$

B.  $\frac{41f}{31}$

C.  $\frac{9f}{25}$

D.  $\frac{25f}{9}$

**Answer: D**



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71. According to Moseley's law, the ratio of the slope of graph between  $\sqrt{f}$  and  $Z$  for  $K_\beta$  and  $K_\alpha$  is

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

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

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

D.  $\sqrt{\frac{36}{5}}$

**Answer: A**



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

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

B.  $\frac{e^2 c}{2\pi h}$

C.  $\frac{e^2 h}{2\pi hc}$

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

**Answer: D**



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**73.** If scattering particles are 56 for  $90^\circ$  angle than this will be at  $60^\circ$  angle

A. 224

B. 256

C. 98

D. 108

**Answer: A**



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**74.** de-Broglie wavelength of an electron in the  $n$ th Bohr orbit is  $\lambda_n$  and the angular momentum is  $J_n$  then

A.  $J_n \propto \lambda_n$

B.  $\lambda_n \propto \frac{1}{J_n}$

C.  $\lambda_n \propto J_n^2$

D. None of these

**Answer: A**



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**75.** In hydrogen atom, electron makes transition from  $n = 4$  to  $n = 1$  level. Recoil momentum of the  $H$  atom will be

a.  $13.6 \times 10^{-19} \text{ kgms}^{-1}$  b.

$6.8 \times 10^{-27} \text{ kgms}^{-1}$

c.  $12.75 \times 10^{-24} \text{ kgms}^{-1}$  d. None of these

**A.  $13.6 \times 10^{-19} \text{ kgms}^{-1}$**

B.  $6.8 \times 10^{-27} \text{ kgms}^{-1}$

C.  $12.75 \times 10^{-24} \text{ kgms}^{-1}$

D. None of these

**Answer: B**



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**76.** The radius of hydrogen atom in its ground state is  $5.3 \times 10^{-11} \text{ m}$ . After collision with an electron it is found to have a radius of



$21.2 \times 10^{-11} m$ . What is the principal quantum number  $n$  of the final state of atom ?

A.  $n=4$

B.  $n=2$

C.  $n=16$

D.  $n=3$

**Answer: B**



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

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

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

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

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

**Answer: C**



**Watch Video Solution**

78. An  $\alpha$ -particle accelerated through  $V$  volt is fired towards a nucleus . Its distance of closest approach is  $r$ . If a proton acceleration through the same potential is fired towards the same nucleus, the distance of closest approach of proton will be  $xr$ . Find value of  $x$ .

A.  $r$

B.  $2r$

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

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

**Answer: A**



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**79.** In a Rutherford scattering experiment when a projectile of charge  $Z_1$  and mass  $M_1$  approaches a target nucleus of charge  $Z_2$  and mass  $M_2$ , the distance of closest 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. directly proportional to  $Z_1$

D. directly proportional to mass  $M_1$

**Answer: B**



**Watch Video Solution**

**80.** 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 charge on the

electron and  $\epsilon_0$  is the vacuum permittivity, the speed of the electron is

A.  $\frac{e}{\sqrt{\epsilon_0 a_0 m}}$

B. zero

C.  $\frac{e}{\sqrt{4\pi\epsilon_0 a_0 m}}$

D.  $\frac{\sqrt{4\epsilon_0 a_0 m}}{e}$

**Answer: C**



**Watch Video Solution**

**81.** For the first member of Balmer series of hydrogen spectrum, the wavelength is  $\lambda$ . What is the wavelength of the second member?

a.  $\frac{27}{20}\lambda$  b.  $\frac{20}{27}\lambda$  c.  $\frac{27}{10}\lambda$  d. None of these

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

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

C.  $\frac{27}{10}\lambda$

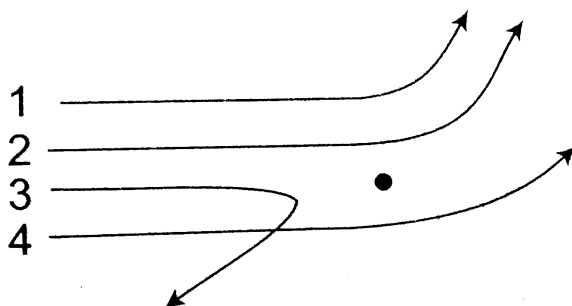
D. None of these

**Answer: B**



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**82.** The diagram shown the path of four  $\alpha$ -particles of the same energy being scattered by the nucleus of an atom simultaneously. Which of these are/is not physically possible ?



A. Both 3 and 4

B. Both 2 and 3



C. Both 1 and 4

D. Only 4

**Answer: D**



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**83.** In a hydrogen atom, the binding energy of the electron in the ground state is  $E_1$  then the frequency of revolution of the electron in the  $n$ th orbit is

A.  $\frac{2E_1}{n^3h}$

B.  $\frac{2E_1n^3}{h}$

C.  $\sqrt{\frac{2mE_1}{n^3h}}$

D.  $\frac{E_1n^2}{h}$

**Answer: A**



**Watch Video Solution**

**84.** The ratio of the wavelengths for  $2 \rightarrow 1$  transition in  $Li^{++}$ ,  $He^{+}$  and  $H$  is

A. 1 : 2 : 3

B. 1 : 4 : 9

C. 2 : 9 : 36

D. 3 : 2 : 1

**Answer: C**



**Watch Video Solution**

**85.** The electron in a hydrogen atom makes a transition from M shell to L-shell. The ratio of

magnitude of initial to final acceleration of the electron is

A. 9 : 4

B. 81 : 16

C. 4 : 9

D. 16 : 81

**Answer: D**



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**86.** If the wavelength of the first line of the Balmer series of hydrogen atom is  $6561\text{\AA}$ , the wavelength of the second line of the series should be

a.  $13122\text{\AA}$  b.  $3280\text{\AA}$  c.  $4860\text{\AA}$  d.  $2187\text{\AA}$

A.  $13122\text{\AA}$

B.  $3280\text{\AA}$

C.  $4860\text{\AA}$

D.  $2187\text{\AA}$

**Answer: C**



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87. If the wavelength of the first member of Balmer series of hydrogen spectrum is  $6563\text{\AA}$ , then the wavelength of second member of Balmer series will be

A.  $1215\text{\AA}$

B.  $4861\text{\AA}$

C.  $6050\text{\AA}$

D. data given is insufficient to calculate the value

**Answer: B**



**Watch Video Solution**

**88.** The wavelength of  $K_{\alpha}$  line for an element of atomic number 43 is  $\lambda$ . Then the wavelength for  $K_{\alpha}$  line for an element of atomic number 29 is

A.  $\frac{43}{29} \lambda$

B.  $\frac{42}{28} \lambda$

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

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

**Answer: C**



**Watch Video Solution**

**89.** For the ground state, the electron in the H-atom has an angular momentum =  $h$ , according to the simple Bohr model. Angular



momentum is a vector and hence there will be infinitely many orbits with the vector pointing in all possible directions. In actuality this is not true,

A. because Bohr model gives incorrect values of angular momentum

B. because only one of these would have a minimum

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

D. because electrons go ground only in horizontal orbits

**Answer: A**



**Watch Video Solution**

90. if  $\lambda_{Cu}$  is the wavelength of  $K_{\alpha}$  X-ray line for copper (atomic number 29) and  $\lambda_{Mo}$  is the wavelength of the  $K_{\alpha}$  X-ray line of molybdenum (atomic number 42), then the ratio  $\frac{\lambda_{Cu}}{\lambda_{Mo}}$  is close to

(a) 1.99

(b) 2.14

(c ) 0.50

(d) 0.48

A. 1.99

B. 2.14

C. 0.5

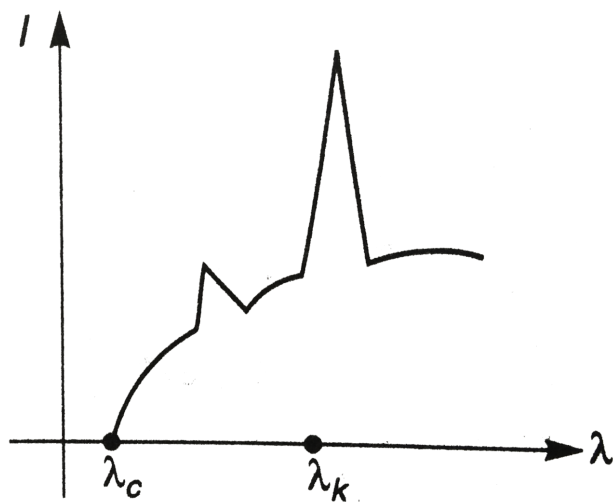
D. 0.48

**Answer: B**



**Watch Video Solution**

91. The intensity of X-rays from a Coolidge tube is plotted against wavelength  $\lambda$  as shown in the figure. The minimum wavelength found is  $\lambda_c$  and the wavelength of the  $K_\alpha$  line is  $\lambda_k$ . As the accelerating voltage is increased



(a)  $\lambda_k - \lambda_c$  increases (b)  $\lambda_k - \lambda_c$  decreases

(c)  $\lambda_k$  increases (d)  $\lambda_k$  decreases

A.  $(\lambda_k - \lambda_c)$  increases

B.  $(\lambda_k - \lambda_c)$  decreases

C.  $\lambda_k$  increases

D.  $\lambda_k$  decreases

**Answer: A**



**Watch Video Solution**

92. Which element has a  $K_{\alpha}$  line of wavelength  $1.785\text{\AA}$  ?

A. Copper

B. cobalt

C. Sodium

D. Aluminium

**Answer: B**



**Watch Video Solution**

93. A H-atom moving with speed  $v$  makes a head on collision with a H-atom at rest. Both atoms are in ground state. The minimum value of velocity  $v$  for which one of the atom may excite is  $(1.25n \times 10^4)$  m/s Find value of  $x$ .

A.  $6.25 \times 10^4 \text{ m s}^{-1}$

B.  $8 \times 10^4 \text{ m s}^{-1}$

C.  $7.25 \times 10^4 \text{ m s}^{-1}$

D.  $13.6 \times 10^4 \text{ m s}^{-1}$

**Answer: A**





94. 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. 4

B. 1

C. 2

D. 3



**Answer: C**



**Watch Video Solution**

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

A.  $+3.4eV$

B.  $+1.51eV$

C.  $-3.4eV$

D.  $-1.51eV$

**Answer: D**



**Watch Video Solution**

**96.** A hydrogen-like atom emits radiation of frequency  $2.7 \times 10^{15}$  Hz when it makes a transition from  $n = 2$  to  $n = 1$ . The frequency

emitted in a transition from  $n = 3$  to  $n = 1$  will be

A.  $1.8 \times 10^{15} \text{ Hz}$

B.  $3.2 \times 10^{15} \text{ Hz}$

C.  $4.7 \times 10^{15} \text{ Hz}$

D.  $6.9 \times 10^{15} \text{ Hz}$

**Answer: B**



**Watch Video Solution**

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

A. 10.20 eV

B. 20.40 eV

C. 13.6 eV

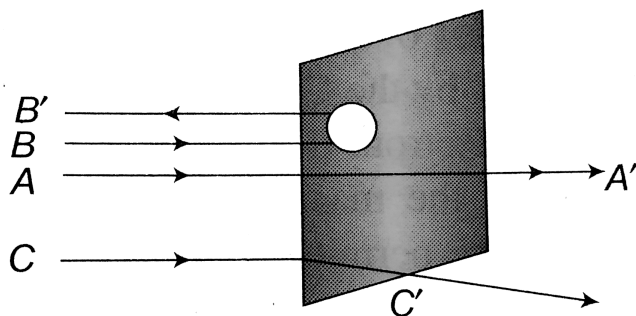
D. 27.2 eV

**Answer: A**



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**98.** A beam of fast moving alpha particles were directed towards a thin film of gold. The parts  $A'$ ,  $B'$  and  $C'$  of the transmitted and reflected beams corresponding to the incident parts  $A$ ,  $B$  and  $C$  of the beam, are shown in the adjoining diagram. The number of alpha particles in



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

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

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

D.  $c'$  will be minimum and in  $B'$  maximum

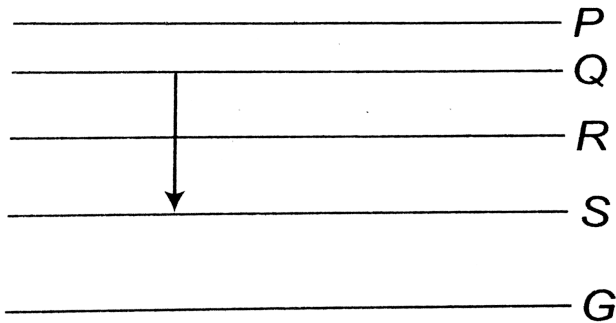
**Answer: B**



**Watch Video Solution**

**99.** Figure shows the energy levels  $P, Q, R, S$  and  $G$  of an atom where  $G$  is the ground state. A red line in the emission spectrum of the atom can be obtained by an energy level

change from  $Q$  to  $S$ . A blue line can be obtained by following energy level change



A. P to Q

B. Q to P

C. R to S

D. R to G

**Answer: D**



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

$$B = - \frac{me^4}{8n^2\epsilon_0^2h^2} \text{ (m= electron mass)}$$

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

$$B = - \frac{Me^4}{8n^2\epsilon_0^2h^2} \text{ (M = proton mass)}$$

This last expression is not correct, because



A.  $n$  would not be integral

B. Bohr-quantisation applies only two electron

C. the frame in which the electron is at rest is not inertial

D. the motion of the proton would not be in circular orbits, even approximately.

**Answer: C**



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**101.** If the intensity of an X-ray becomes  $\frac{I_0}{2}$  from  $I_0$  after travelling 2.0 cm inside a target, then its intensity after travelling a distance of 4 cm will be

A.  $\frac{I_0}{2}$

B.  $\frac{I_0}{4}$

C.  $2I_0$

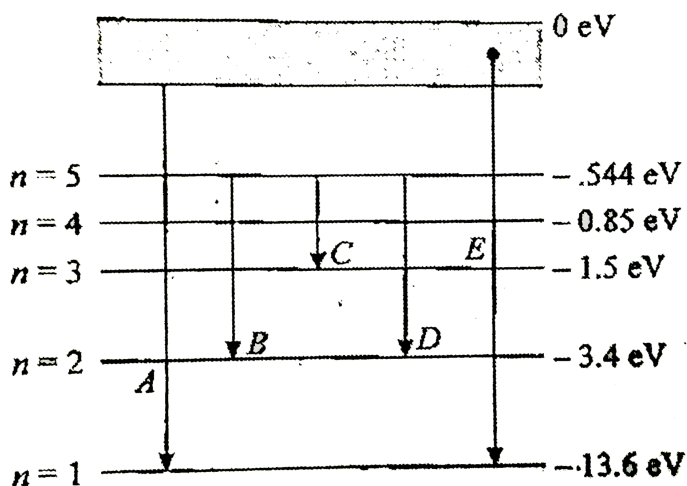
D.  $I_0$

**Answer: B**



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**102.** In the following figure the energy levels of hydroge atom have been shown along with some transitions marked A, B,C,D and E.The transitionsy A,B and C respectively represent:



A. the first member of the Lyman series,  
third member of Balmer series and  
second member of Paschen series

B. the ionisation potential of H, second  
member of Balmer series and third  
member of Paschen series

C. the series limit of Lyman series, second  
member of Balmer series and second  
member of Paschen series

D. the series limit of Lyman series, third member of Balmer series and second member of Paschen series

**Answer: D**



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**103.** The ionization energy of the electron in the hydrogen atom in its ground state is  $13.6\text{ eV}$ . 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.  $n=3$  and  $n=2$  states

B.  $n=3$  and  $n=1$  state

C.  $n=2$  and  $n=1$  state

D.  $n=4$  and  $n=3$  states

**Answer: D**



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**104.** If an electron is revolving around the hydrogen nucleus at a distance of 0.1 nm, what should be its speed?

A.  $2.188 \times 10^6 \text{ ms}^{-1}$

B.  $1.094 \times 10^6 \text{ ms}^{-1}$

C.  $4.376 \times 10^6 \text{ ms}^{-1}$

D.  $1.60 \times 10^6 \text{ ms}^{-1}$

**Answer: D**



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**105.** Imagine an atom made of a proton and a hypothetical particle of double the mass of the electron but having the same charge as the electron. Apply the Bohr atom model and consider all possible transitions of this hypothetical particle of the first excited level. the longest wavelength photon that will be emitted has wavelength [given in terms of the Rydberg constant  $R$  for the hydrogen atom] equal to

A.  $\frac{9}{(5R)}$



B.  $\frac{36}{(5R)}$

C.  $\frac{18}{(5R)}$

D.  $\frac{4}{(5R)}$

**Answer: C**



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**106.** 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 radiations

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

**Answer: B**



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**107.** The electron in a hydrogen atom makes a transition  $n_1 \rightarrow n_2$ , 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.  $n_1 \Delta n_2 = 2$

B.  $n_1 8, n_2 = 2$

C.  $n_1 \Delta, n_2 = 1$

D.  $n_1 = 6, n_2 = 2$

**Answer: A**



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**108.** If electron with principal quantum number  $n > 4$  were not allowed in nature , the number of possible element would be

A. 32

B. 60

C. 18

D. 4

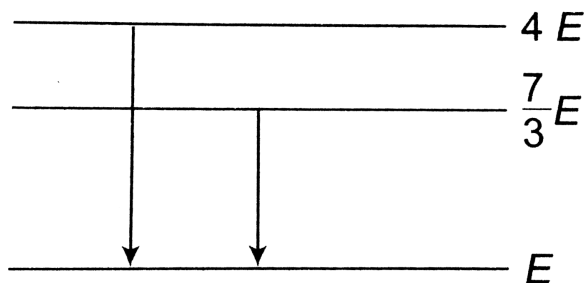
**Answer: B**



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**109.** The following diagram indicates the energy levels of a certain atom when the system moves from  $4E$  level to  $E$ . A photon of wavelength  $\lambda_1$  is emitted. The wavelength of photon produced during its transition from

$\frac{7}{3}E$  level to  $E$  is  $\lambda_2$ . the ratio  $\frac{\lambda_1}{\lambda_2}$  will be



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

B.  $\frac{4}{8}$

C.  $\frac{3}{8}$

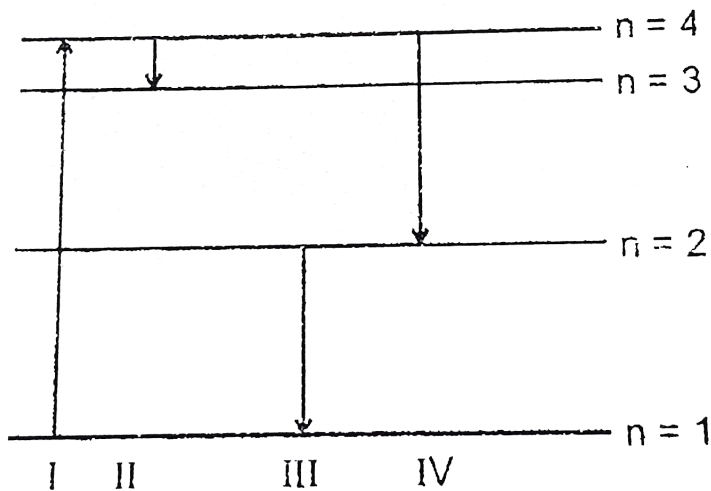
D.  $\frac{5}{9}$

**Answer: A**



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



A. III

B. IV

C. I

D. II

**Answer: A**



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**111.** When the voltage applied to an X-ray tube is increased from  $V_1 = 10$  kV to  $V_2 = 20$  kV, the wavelength difference between limit of the continuous X-ray spectrum increases by a factor



3 The atomic number of the element of which the tube anticathode is made will be  $(30-x)$ ,

Find Value of  $x$ .

A. 62

B. 56

C. 45

D. 29

**Answer: D**



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**112.** The ionisation potential of hydrogen atom is  $-13.6\text{ eV}$ . An electron in the ground state of a hydrogen atom absorbs a photon of energy  $12.75\text{ eV}$ . How many different spectral lines can one expect when the electron make a downward transition

A. 1

B. 4

C. 2

D. 6

**Answer: D**



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**113.** The distance of closest approach of an alpha-particle fired towards a nucleus with momentum  $p$  is  $r$ . What will be the distance of closest approach when the momentum of alpha-particle is  $2p$ ?

A.  $r/2$

B.  $2r$

C.  $4r$

D.  $r/4$

**Answer: D**



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**114.** The first excited state of hydrogen atom is  $10.2\text{eV}$  above its ground state. The temperature is needed to excite hydrogen atoms to first excited level is

A.  $7.9 \times 10^4 K$

B.  $3.5 \times 10^4 K$

C.  $5.8 \times 10^4 K$

D.  $14 \times 10^4 K$

**Answer: A**



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**115.** Hydrogen ( ${}_1 H^1$ ), Deuterium ( ${}_1 H^2$ ), singly ionised Helium ( ${}_2 He^+$ ) and doubly ionised lithium ( ${}_3 Li^{++}$ ) all have one

electron around the nucleus. Consider an electron transition from  $n = 2$  to  $n = 1$ . If the wave lengths of emitted radiation are  $\lambda_1, \lambda_2, \lambda_3$  and  $\lambda_4$  respectively then approximately which one of the following is correct?

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

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

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

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

**Answer: C**



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**116.** suppose an electron is attracted towards the origin by a force  $k/r$ , where  $k$  is a constant and  $r$  is the distance of the electron from the origin. By applying bohr model to this system, the radius of  $n^{th}$  orbit of the electron is found to be  $r_n$  and the kinetic energy of the electron is found to be  $T_n$  Then which of the following is true ?

A.  $T_n$  indepnednt of  $n$ ,  $r_n \propto n$

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

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

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

**Answer: A**



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**117.** A hydrogen like atom of atomic number  $Z$  is in an excited state of quantum number  $2n$ . It can emit a maximum energy photon of 204 eV. If it makes a transition to quantum state  $n$ , a



photon of energy 40.8 eV is emitted. Find  $n$ ,  $Z$  and the ground state energy (in eV) of this atom. Also calculate the minimum energy(eV) that can be emitted by this atom during de - excitation. Ground state energy of hydrogen atom is -13.6 eV

A. 1

B. 2

C. 3

D. 4

**Answer: B**



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## Assertion And Reason

1. Assertion: Angular momentum of single electron in any orbit or hydrogen type atom is independent of the atomic number of the element.

Reason: In ground state angular momentum is minimum

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion

C. If Assertion is true by Reason is false.

D. If Assertion is false but Reason is true.

**Answer: B**



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2. Assertion The radius of second orbit of hydrogen atom is  $2.1\text{\AA}$

Reason Radius of  $n$ th orbit of hydrogen atom

$$r_n \propto n^2$$

A. If both Assertion and Reason are true and

Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true

but Reason is not correct explanation of

## Assertion

C. If Assertion is true by Reason is false.

D. If Assertion is false but Reason is true.

**Answer: B**



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3. Assertion Energy  $E_1$  is required to remove first electron from helium atom and energy  $E_2$  is to required to remove the second electron .

Them  $E_1 < E_2$ .

Reason Ionisation energy of single electron of

$He^+$  is 54.4 eV.

A. If both Assertion and Reason are true and

Reason is the correct explanation of

Assertion.

B. If both Assertion and Reason are true

but Reason is not correct explanation of

Assertion

C. If Assertion is true by Reason is false.

D. If Assertion is false but Reason is true.

**Answer: B**



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**4. Assertion :** The spectral series 'Balmer' of the hydrogen atom lies in the visible region of the electromagnetic spectrum

**Reason :** Wavelength of light in the visible region lies in the range of 400 nm to 700 nm

A. If both Assertion and Reason are true and

Reason is the correct explanation of

Assertion.

B. If both Assertion and Reason are true  
but Reason is not correct explanation of  
Assertion

C. If Assertion is true by Reason is false.

D. If Assertion is false but Reason is true.

**Answer: B**



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5. Assertion: It is essential that all the lines available in the emission spectrum will also be available in the absorption spectrum.

Reason: The spectrum of hydrogen atom is only absorption spectrum.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not correct explanation of

Assertion

C. If Assertion is true by Reason is false.

D. If both Assertion and Reason are false.

**Answer:**



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6. Assertion Second orbit circumference of hydrogen atom is two times the de-Broglie wavelength of electrons in that orbit

Reason de-Broglie wavelength of electron in ground state is minimum.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion

C. If Assertion is true by Reason is false.

D. If Assertion is false but Reason is true.

**Answer: B**



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7. Assertion By increasing the acceleration voltage in coolidge tube wavelength of characteristic X-rays does not change.

Reason Cut-off wavelength is inversely proportional to the acceleration voltage

A. If both Assertion and Reason are true and

Reason is the correct explanation of

Assertion.

B. If both Assertion and Reason are true  
but Reason is not correct explanation of  
Assertion

C. If Assertion is true by Reason is false.

D. If Assertion is false but Reason is true.

**Answer: B**



**Watch Video Solution**

**8. Assertion** Energy of characteristic X-rays is more than the energy of continuous X-rays

**Reason** Characteristic X-rays are produced due to transition of electrons from higher energy states to lower energy states.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not correct explanation of

## Assertion

C. If Assertion is true by Reason is false.

D. If Assertion is false but Reason is true.

**Answer: D**



**Watch Video Solution**

**9. Assertion:** Wavelength of characteristic X-rays is given by

$$\frac{1}{\lambda} \propto \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

in the transition from  $n_2 \rightarrow n_1$  . In the above relation proportionally constant does not depend upon the target material.

Reason :Continuous X-rays are target independent.

A. If both Assertion and Reason are true and

Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true

but Reason is not correct explanation of Assertion



C. If Assertion is true by Reason is false.

D. If Assertion is false but Reason is true.

**Answer: B**



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**10.** Assertion Wavelength of characteristic X-rays is given by

$$\frac{1}{\lambda} \propto \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

in transition from  $n_2 \rightarrow n_1$ . In the above relation proportionality constant is series

dependent. For different series (K-series, L-series, etc. ) value of this constant will be different.

Reason For L-series value of this constant is less than the value for K-series

A. If both Assertion and Reason are true and

Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true

but Reason is not correct explanation of Assertion

C. If Assertion is true by Reason is false.

D. If Assertion is false but Reason is true.

**Answer: C**



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## Match The Columns

1. In Column I physical quantities corresponding to hydrogen and hydrogen like atom are given. In column II, powers of

principal quantum number  $n$  are given on which those physical quantities depend.

Match the two columns.

Column I		Column II
A. Angular velocity of circular motion of electron	(p)	- 4
B. Centripetal acceleration in circular motion of electron	(q)	1
C. Angular momentum of electron	(r)	- 3
D. Moment of inertia of electron about centroidal axis	(s)	4

Ground state energy of hydrogen atom is  $E_0$ . Match the following two columns.



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2. Ground state energy of hydrogen atom is  $E_0$ . Match the following two columns.

Column I		Column II
A.	Electrostatic potential energy in ground state of hydrogen atom (p)	$E_0$
B.	Total energy in first excited state of $\text{He}^+$ ion (q)	$-E_0$
C.	Kinetic energy of electron in first excited state of $\text{He}^+$ ion (r)	$2E_0$
D.	Kinetic energy of electron in ground state of hydrogen atom (s)	$-2E_0$



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3. Wavelength of X-ray photon is  $a$  and momentum of X-ray photon is  $b$ .

Now, match the following two columns

Column I		Column II
A.	Wavelength of $\gamma$ -ray photon (p)	$> a$
B.	Momentum of $\gamma$ -ray photon (q)	$< a$
C.	Wavelength of UV ray photon (r)	$> b$
D.	Momentum of UV ray photon (s)	$< b$



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#### 4. Match the Column :

Column I	Column II
A. $\frac{Z^3}{n^5}$	(p) Angular speed
B. $\frac{Z^2}{n^2}$	(q) Magnetic field at the centre due to revolution of electron
C. $\frac{Z^2}{n^3}$	(r) Potential energy of an electron in $n$ th orbit
D. $\frac{Z}{n}$	(s) Speed of electron in $n$ th orbit



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Medical Entrances Gallery

1. Given the value of Rydberg constant is  $10^7 m^{-1}$ , the waves number of the last line of the Balmer series in hydrogen spectrum will be:

A.  $0.5 \times 10^7 m^{-1}$

B.  $0.25 \times 10^7 m^{-1}$

C.  $2.5 \times 10^7 m^{-1}$

D.  $0.025 \times 10^4 m^{-1}$

**Answer: B**



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2. When an  $\alpha$  particle of mass  $m$  moving with velocity  $v$  bombards on a heavy nucleus of charge  $Ze$ , its distance of closest approach from the nucleus depends on  $m$  as

A.  $\frac{1}{\sqrt{m}}$

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

C.  $m$

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

**Answer: D**





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3. Electrons of mass  $m$  with de-Broglie wavelength  $\lambda$  fall on the target in an X-ray tube. The cut-off wavelength ( $\lambda_0$ ) of the emitted X-ray 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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4. If an electron in a hydrogen atom jumps from the 3rd orbit to the 2nd orbit, it emits a photon of wavelength  $\lambda$ . When it jumps from the 4th orbit to the 3rd orbit, the corresponding wavelength of the photon will be

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

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

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

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

**Answer: C**



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**5. Number of spectral lines in hydrogen atom is**

**A. 8**

B. 6

C. 15

D.  $\infty$

**Answer: D**



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**6.** Minimum excitation potential of Bohr's first orbit in hydrogen atom is

A. 13.6 V

B.  $-13.6V$

C.  $10.2\text{ V}$

D.  $-10V$

**Answer: C**



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7. If the frequency of  $K_{\alpha}$ ,  $K_{\beta}$  and  $L_{\alpha}$  , X-ray lines of a substance are  $\nu_{K_{\alpha}}$ ,  $\nu_{K_{\beta}}$ , and  $\nu_{L_{\beta}}$

A.  $\nu_{K_{\beta}} = \nu_{K_{\alpha}} + \nu_{L_{\alpha}}$

B.  $v_{K_\beta} = v_{K_\alpha} - v_{L_\alpha}$

C.  $v_{K_\beta} = \frac{v_{K_\alpha}}{v_{L_\alpha}}$

D.  $v_{K_\beta}^2 = \frac{v_{K_\alpha} \cdot v_{L_\alpha}}{2}$

**Answer: A**



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**8.** The magnetic moment ( $\mu$ ) of a revolving electron around the nucleus varies with principal quantum number  $n$  as

A.  $\mu \propto 1/n$

B.  $\mu \propto 1/n^2$

C.  $\mu \propto n$

D.  $\mu \propto n^2$

**Answer: C**



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**9.** The ionization energy of the electron in the hydrogen atom in its ground state is  $13.6\text{eV}$ . The atoms are excited to higher energy levels

to emit radiations of 6 wavelengths. Maximum wavelength of emitted radiation corresponds to the transition between

A.  $n=3$  to  $n=1$  states

B.  $n=4$  to  $n=3$  states

C.  $n=3$  to  $n=2$  states

D.  $n=2$  to  $n=1$  states

**Answer: B**



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10. A photon of wavelength 300nm interacts with a stationary hydrogen atom in ground state. During the interaction, whole energy of the photon is transferred to the electron of the atom. State which possibility is correct, (consider, Planck's constant  $= 4 \times 10^{-15}$  eVs, velocity of light  $= 3 \times 10^8 \text{ ms}^{-1}$  ionisation energy of hydrogen =13.6 eV)

A. Electron will be knocked out of the atom

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

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

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

**Answer: D**



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**11.** Consider 3rd orbit of  $He^+$  (Helium) using nonrelativistic approach the speed of electron in this orbit will be (given  $K = 9 \times 10^9$

constant  $Z = 2$  and  $h$  (Planck's constant)  
 $= 6.6 \times 10^{-34} Js$ .)

A.  $2.29 \times 10^6 ms^{-1}$

B.  $1.46 \times 10^6 ms^{-1}$

C.  $0.73 \times 10^6 ms^{-1}$

D.  $3 \times 10^8 ms^{-1}$

**Answer: B**



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12. What is the wavelength of light for the least energetic photon emitted in the Lyman series of the hydrogen spectrum. (Take ,  $hc = 1240 \text{ eV} \cdot \text{nm}$ )

A. 122nm

B. 82nm

C. 150nm

D. 120nm

**Answer: A**



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13. The wavelength of  $k_{\alpha}$  X- rays produced by an X - rays tube is  $0.76\text{\AA}$  . The atomic number of the anode material of the tube is .....

A. 20

B. 60

C. 41

D. 80

**Answer: C**





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**14.** The de-Broglie wavelength of an electron in 4th orbit is (where,  $r$ =radius of 1st orbit)

A.  $2\pi r$

B.  $4\pi r$

C.  $8\pi r$

D.  $16\pi r$

**Answer: C**



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**15.** The de-Broglie wavelength of an electron is the same as that of a 50 keV X-ray photon. The ratio of the energy of the photon to the kinetic energy of the electron is ( the energy equivalent of electron mass of 0.5 MeV)

A. 1 : 50

B. 1 : 20

C. 20 : 1

D. 50 : 1

**Answer: C**



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

A. 3.4 eV

B. 4.53 eV

C. 10.2 eV



D. 13.6eV

**Answer: C**



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

A. 3

B. 2

C. 6

D. 10

**Answer: A**



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**18.** If, an electron in hydrogen atom jumps from an orbit of level  $n=3$  to an orbit of level  $n=2$ , emitted radiation has a frequency ( $R$  = Rydberg's constant,  $c$  = velocity of light)

A.  $\frac{3Rc}{27}$

B.  $\frac{3Rc}{25}$

C.  $\frac{8Rc}{9}$

D.  $\frac{5Rc}{36}$

**Answer: D**



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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.  $\frac{5}{27}$

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

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

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

**Answer: A**



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**20.** The Rutherford charge experiment proves  
than an atom consists of

A. a sphere of positive charge in which  
electrons are embedded like seeds of  
water-melon

B. a sphere of negative charge in which  
protons are embedded like seeds of  
water-melon

C. a sphere of electrons cloud in which the positive charge is placed at the centre of the sphere

D. a sphere of neutral charge

**Answer: C**



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**21.** According to Bohrr model of hydrogen atom, only those orbit are permissible which satisfy the condition

A.  $mv = nh$

B.  $\frac{mv^2}{r} = n \left( \frac{h}{2\pi} \right)$

C.  $mvr = n \left( \frac{h}{2\pi} \right)$

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

**Answer: C**



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**22.** In Moseley's law  $\sqrt{\nu} = a(z - b)$ , the value of the screening constant for K-series and L-series of X-rays are respectively

A. 1, 6.4

B. 1,4

C. 4,6

D. 2,4

**Answer: A**



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**23.** The  $K_{\alpha}$  X-rays of molybdenum has a wavelength of  $71 \times 10^{-12} m$ . If the energy of molybdenum atom with molybdenum atom



when an L-electron is removed

$$(hc = 12.42 \times 10^{-7} eV)$$

A. 17.5 keV

B. 40.82 keV

C. 23.32 keV

D. 5.28 keV

**Answer: D**



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**24.** Pick out the correct statement from the following

A. Mercury vapour lamp produces line emission spectrum

B. Oil flame produces line emission spectrum

C. Band spectrum helps us to study molecular structure

D. Sunlight spectrum is an example for line  
absorption spectrum

**Answer: A::C::D**



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**25.** Light emitted during the de excitation of  
electrons from  $n=3$  to  $n=2$ , when incident on  
metal, photoelectrons following de excitations  
photoelectrons are just emitted from that

metal. In which of the following de excitations photoelectric effect, is not possible ?

A. From  $n=2$  to  $n=1$

B. From  $n=3$  to  $n=1$

C. From  $n=5$  to  $n=2$

D. From  $n=$  to  $n=1$

**Answer: D**



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**26.** The binding energy of an electron in the ground state of He atom is equal to  $E_0 = 24.6\text{eV}$ . Find the energy required to remove both electrons from the atom.

A. 51.8 eV

B. 79 eV

C. 38.2 eV

D. 49.2 eV

**Answer: B**



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27. The figure shows the energy level of certain atom. When the electron de excites from  $3E$  to  $E$ , an electromagnetic wave of wavelelngth  $\lambda$  is emitted. What is the wavelelngth of the electromagnetic wave emitted when the electron de excites from  $\frac{5E}{3}$  to  $E$ ?

\_\_\_\_\_  $3E$

\_\_\_\_\_  $5E/3$

\_\_\_\_\_ E ?

\_\_\_\_\_  $3E$

\_\_\_\_\_  $5E/3$

\_\_\_\_\_  $E$

A.  $3\lambda$

B.  $2\lambda$

C.  $5\lambda$

D.  $\frac{3\lambda}{5}$

**Answer: A**



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**28. Spectrum of X-rays is**

A. continuous

B. linear

C. continuous and linear

D. band

**Answer: A**



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**29.** The spectral series of the hydrogen spectrum that lies in the ultraviolet region is the

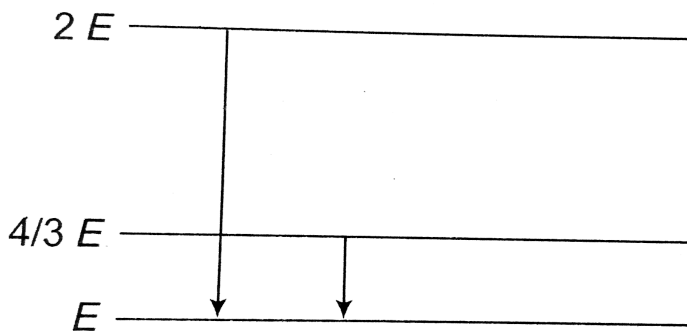
- A. Balmer series
- B. Brackett series
- C. Paschen series
- D. Lyman series

**Answer: D**



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30. The following diagram indicates the energy levels of a certain atom when the system moves from  $2E$  level to  $E$ , a photon of wavelength  $\lambda$  is emitted. The wavelength of photon produced during its transition from  $\frac{4E}{3}$  level to  $E$  is



A.  $3\lambda$

B.  $\lambda / 3$

C.  $3\lambda / 3$

D.  $4\lambda / 3$

**Answer: A**



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**31.** As per the Bohr model, the minimum energy (in eV) required to remove an electron from ground state of doubly ionized Li atom ( $Z = 3$ ) is

A. 1.51

B. 28.7

C. 53.9

D. 122.4

**Answer: D**



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**32.** If the series limit of Lyman series for hydrogen atom is equal to the series limit of Balmer series for a hydrogen like atom then

atomic number of this hydrogen like atom will be

A. 1

B. 2

C. 3

D. 4

**Answer: B**



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**33.** The ratio of wavelengths of photons emitted when hydrogen atom de-excites from third excited state to second excited state then de-excites from second excited state to first excited state is :

A.  $7/5$

B.  $27/20$

C.  $27/5$

D.  $20/7$

**Answer: D**



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**34.** An electron of a stationary hydrogen atom passes from the fifth energy level to the ground level. The velocity of hydrogen atom acquired as a result of photon emission will be

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

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

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

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

**Answer: A**



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**35.** Assertion Balmer series lies in the visible region of electromagnetic spectrum.

Reason  $\frac{1}{\lambda} = R \left( \frac{1}{2^2} - \frac{1}{n^2} \right)$ , where  $n = 3, 4, 5, \dots$



A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If both Assertion and Reason are false.

**Answer: A**



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**36.** Assertion A beam of charged particles is employed in the treatment of cancer.

Reason Charged particles on passing through a material medium loss their energy by causing ionisation of the atoms along their path.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If both Assertion and Reason are false.

**Answer: B**



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**37.** In Bohr model of hydrogen atom, the force on the electron depends on the principal quantum number ( $n$ ) as

A. independent of  $n$

B.  $F \propto \frac{1}{n^5}$

C.  $F \propto \frac{1}{n^4}$

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

**Answer: C**



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**38.** The wavelength of  $K_\alpha$  line copper is  $1.5\text{\AA}$ .

The ionisation energy of K electron in copper is

A.  $11.2 \times 10^{-17} J$

B.  $12.9 \times 10^{-16} J$

C.  $1.7 \times 10^{-15} J$

D.  $10 \times 10^{-16} J$

**Answer: B**



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**39.** The wavelength of first line of Balmer series is  $6563\text{\AA}$ . The wavelength of first line of Lyman series will be

A.  $1215.4\text{\AA}$

B.  $2500\text{\AA}$

C.  $7500\text{\AA}$

D.  $600\text{\AA}$

**Answer: A**



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**40.** The electron of a hydrogen atom revolves the proton in a circuit nth of radius

$$r_0 = \frac{\epsilon_0 n^2 h^2}{\pi m e^2} \text{ with a speed } v_0 = \frac{e^2}{2 \epsilon_0 n h}$$

The current the to circulating charge is proportional to

A.  $e^2$

B.  $e^3$

C.  $e^5$

D.  $e^6$

**Answer: C**



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41. If an X-ray tube operates at the voltage of 10kV, find the ratio of the de-broglie wavelength of the incident electrons to the shortest wavelength of X-ray producted. The specific charge of electron is  $1.8 \times 10^{11} \frac{C}{kg}$ .

A. 0.1

B. 0.2

C. 0.3



D. 1.0

**Answer: A**



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**42.** Consider a hydrogen-like atom whose energy in  $n$ th 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

$E_{\max} = 52.224\text{eV}$ . and least energetic photons have energy

$$E_{\min} = 1.224\text{eV}$$

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

- A. 2
- B. 4
- C. 5
- D. None of these

**Answer: A**





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