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SAIVEERA ACADEMY
COIMBATORE - 8098850809
12TH PHYSICS UNIT -7 FULL TEST

Marks : 55 **Time :** 1 hr 10 min

I.CHOOSE THE BEST ANSWERS **10 × 1 =10**

1.In an electron microscope, the electrons are accelerated by a voltage of 14 *kV*. If the voltage is changed to 22.4 *kV*, then the de Broglie wavelength associated with the electrons would

a. increase by 1.26 times b. decrease by 1.26 times
c. decrease by 4 times d. increase by 4 times

2. When a metallic surface is illuminated with radiation of wavelength λ , the stopping potential is *V*. If the same surface is illuminated with radiation of wavelength 2λ , the stopping potential is *V*/ 4 . The threshold wavelength for the metallic surface is

a. 4λ b. 5λ c. 5/ 2 λ d. 3λ

3. If a light of wavelength 330 *nm* is incident on a metal with work function 3.55 *eV*, the electrons are emitted. Then the wavelength of the emitted electron is

a. $< 2.75 \times 10^{-9}$ *m* b. $\geq 2.75 \times 10^{-9}$ *m*
c. $\leq 2.75 \times 10^{-12}$ *m* d. $< 2.75 \times 10^{-10}$ *m*

4. . In photoelectric emission, a radiation whose frequency is 9 times threshold frequency of a certain metal is incident on the metal. Then the maximum possible velocity of the emitted electron will be

a. $\sqrt{\frac{h\upsilon_o}{m}}$ b. $\sqrt{\frac{6h\upsilon_o}{m}}$ c. $4\sqrt{\frac{h\upsilon_o}{m}}$ d. $\sqrt{\frac{h\upsilon_o}{2m}}$

5. Two radiations with photon energies 0.9 eV and 2.1 eV respectively are falling on a metallic surface successively . If the work function of the metal is 0.5 eV, then the ratio of maximum speeds of emitted electrons will be

a) 1:4 b) 1:3 c) 1:2 d)1:9

6. The threshold wavelength for a metal surface whose photoelectric work function is 3.313 *eV* is

a)4125Å b)3750Å c)6000Å d)2062 .5 Å

7. A light of wavelength 400 *nm* is incident on a sensitive plate of photoelectric work function 1.235 *eV*. The kinetic energy of the photo electrons emitted is be
(Take $h = 6.6 \times 10^{-34}$ *Js*)

a) 4.179 *eV* b) 2.48 *eV* c) 1.24 *eV* d) 1.16 *Ev*

8. Particle A and B have electric charge +q and +4q . Both have mass m. If both are allowed to fall under the same potential difference , what will be the ratio of velocities

a)2:1 b) 1:2 c)1:8 d)4:1

9. How many photons of red coloured light having wavelength 8000Ǻ will have same energy as one photon of violet coloured light of wavelength 4000Ǻ?

a) 2 b) 4 (c) 6 (d) 8

10. Wavelength of an electron having energy 20keV is

a) 0.12 Ǻ b) 1.2 Ǻ c) 0.012 Ǻ d)0.9Ǻ

II.ANSWER THE FOLLOWING QUESTIONS **5 × 2 =10**

11.At the given point of time, the earth receives energy from sun at 4 $cal\ cm^{-2}\ min^{-1}$. Determine the number of photons received on the surface of the Earth per cm^2 per minute. (Given : Mean wavelength of sun light = 5500 Å)

12. An electron and an alpha particle have same kinetic energy. How are the de Broglie wavelengths associated with them related?

13. Define work function of a metal. Give its unit

14. What is Bremsstrahlung or braking radiation?

15.What do you meant by stopping potential?

III.ANSWER THE FOLLOWING QUESTIONS **5 × 3 =15**

16.Explain about Production of x-rays

17.Explain about origin of Characteristic x – ray spectra

18.Write the Applications of photo cells

19.Calculate the maximum kinetic energy and maximum velocity of the photoelectrons emitted when the stopping potential is 81V for the photoelectric emission experiment

20.When a 6000Å light falls on the cathode of a photo cell and produced photoemission. If a stopping potential of 0.8 V is required to stop emission of electron, then determine the (i) frequency of the light (ii) energy of the incident photon (iii) work function of the cathode material (iv) threshold frequency and (v) net energy of the electron after it leaves the surface.

IV.ANSWER THE FOLLOWING QUESTIONS **4 × 5 = 20**

21. Describe briefly Davisson – Germer experiment which demonstrated the wave nature of electrons.

22. List out the laws of photoelectric effect.

23. Obtain Einstein's photoelectric equation with necessary explanation.

24.Give the construction and working of photo emissive cell.

Everything you don't know is something you can learn

KEY

I.CHOOSE

1. $\lambda_o = \frac{1.227}{\sqrt{V}}\,\text{Å}$

$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{V_2}{V_1}} = \sqrt{\frac{224000}{14000}} = \sqrt{1.6} = 1.26$

$\lambda_2 = \frac{\lambda_1}{1.26}$

b. decrease by 1.26 times

2. By photo electric equation $eV = hc/\lambda - hc/\lambda_o$

First case

$eV = hc/\lambda - hc/\lambda_o$ ……..(1)

By second case

$eV/4 = hc/\lambda - hc/\lambda_o$

$eV = 4hc/2\lambda - 4hc/\lambda_o$ …….(2)

$hc/\lambda - hc/\lambda_o = 4hc/2\lambda - 4hc/\lambda_o$

$\lambda_o = 3\lambda$

d. 3λ

3. **Hint:** $h\upsilon - \emptyset = K.E$

$\frac{6.626\times10^{-34}\times3\times10^{8}}{330\times10^{-9}} - 3.55 = \text{K.E}$

$6 \times 10^{-19} - 3.55 \times 1.6 \times 10^{-19} = \text{K.E}$

$6 \times 10^{-19} - 5.68 \times 10^{-19} = \text{K.E}$

$\text{K.E} = 0.32 \times 10^{-19}$

$\lambda = \frac{h}{\sqrt{2mE}}$

$\lambda = \frac{6.626\times10^{-34}}{\sqrt{2\times9.1\times10^{-31}\times0.32\times10^{-19}}}$

$= \frac{6.626\times10^{-34}}{2.41\times10^{-25}} = 2.756 \times 10^{-9}$

b. $\geq 2.75 \times 10^{-9}\, m$

4. **Hint:** $: h\upsilon = h\upsilon_o + \frac{1}{2}mv^2$

Given $\upsilon = 9\upsilon_o$

$9h\upsilon_o = h\upsilon_o + \frac{1}{2}mv^2$

$9h\upsilon_o - h\upsilon_o = \frac{1}{2}mv^2$

$8h\upsilon_o = \frac{1}{2}mv^2$

$16h\upsilon_o = mv^2$

$v = \sqrt{\frac{16h\upsilon_o}{m}}$

c. $4\sqrt{\frac{h\upsilon_o}{m}}$

5. First case E = 0.9 eV → $0.9 = 0.5 + \frac{1}{2}mv^2$ → $0.3 = \frac{1}{2}mv_1^2$ ……..(1)

Second case E = 2.1 eV → $2.1 = 0.5 + \frac{1}{2}mv^2$ → $2.7 = \frac{1}{2}mv_2^2$ ……..(2)

Dividing (i) & (2) we get $\frac{v_1^2}{v_2^2} = \frac{1}{4} \rightarrow \frac{v_1}{v_2} = \frac{1}{2}$

c) 1:2

6. **Hint;** $hc/\lambda = \emptyset_o$
$\lambda = 6.626 \times 10^{-34} \times 3 \times 10^{8} / 3.313 \times 1.6 \times 10^{-19} = 3750 \times 10^{-10}$ **b)3750Å**

7. **Hint:** $E = \emptyset_o + K.E$ **Given** $\emptyset_o = 1.235\ eV$ $\lambda = 400\ nm$

K.E = $\frac{hc}{\lambda} - \emptyset_o$ **……..(1)**

Sub Given values in (1)

K.E = $\frac{6.626\times10^{-34}\times3\times10^{8}}{400\times10^{-9}} - 1.235 = 1.24\ eV$ **a)4.179 eV**

8. **Hint :** $v_A = \sqrt{\frac{2qV}{m}}$ $v_B = \sqrt{\frac{16qV}{m}}$

Dividng v_A **&** v_B **we get 1 : 2**

b)1:2

9. $E_1 = \frac{hc}{\lambda_1}$ $E_2 = \frac{nhc}{\lambda_2}$

Since $E_1 = E_2$

$\frac{hc}{\lambda_1} = \frac{nhc}{\lambda_2}$

$\lambda_1 = 8000$ Å $\lambda_2 = 4000$Å

n = 8000/4000 = 2

a)2

10. $\lambda = \frac{h}{\sqrt{2mE}} = \frac{6.626\times10^{-34}}{\sqrt{2\times9.1\times10^{-31}\times20\times10^{4}\times1.6\times10^{-19}}} = 0.9$Å

d)0.9 Å

SAIVEERA ACADEMY
REVOLUTION FOR LEARNING , COIMBATORE 8098850809
12TH PHYSICS UNIT – 8 ATOM TEST

Marks : 65 **Time : 1 hr 30 min**

I.Choose the best answers **20 × 1 = 20**

1. The simple Bohr model cannot be directly applied to calculate the energy levels 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

2. 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

3. An ionised H-molecule consists of an electron and two protons. The protons are separated by a small distance of the order of angstrom. In the ground state,
(a) the electron would not move in circular orbits.
(b) the energy would be $(2)^4$ times that of a H-atom.
(c) the electrons, orbit would go around the protons.
(d) the molecule will soon decay in a proton and a H-atom

4. The Bohr model for the spectra of a H-atom
(a) will not be applicable to hydrogen in the molecular from.
(b) will not be applicable as it is for a He-atom.
(c) is valid only at room temperature.
(d) predicts continuous as well as discrete spectral lines

5. The Balmer series for the H-atom can be observed
(a) if we measure the frequencies of light emitted when an excited atom falls to the ground state.
(b) if we measure the frequencies of light emitted due to transitions between excited states and the first excited state.
(c) in any transition in a H-atom.
(d) as a sequence of frequencies with the higher frequencies getting closely packed.

6. The simple Bohr model is not applicable to He4 atom because
(a) He^4 is an inert gas.
(b) He^4 has neutrons in the nucleus.
(c) He^4 has one more electron.
(d) electrons are not subject to central forces.

7. A narrow electron beam passes undeviated through an electric field $E = 3 \times 10^4$ V/m and an overlapping magnetic field $B = 2 \times 10^{-3}$ Wb/m2 . The electron motion, electric field and magnetic field are mutually perpendicular. The speed of the electron is
a) $60 ms^{-1}$ b) $10.3 \times 10^7 ms^{-1}$ c) $1.5 \times 10^7 ms^{-1}$ d) $0.67 \times 10^7 ms^{-1}$

8.In a Millikan's oil drop the plates A and B are separated by a distance of 16 mm and potential difference applied between the is 10,000 Volt. The electric field between the plates is
a)625V/m b)6.25V/m c)62500V/m d)625000V/m

9. If R is Rydberg's constant, the minimum wavelength of hydrogen spectrum is
a) $\frac{1}{R}$ b) $\frac{R}{4}$ c) $\frac{4}{R}$ d) R

10. If the radius of third Bohr orbit in hydrogen atom is r, then the de Broglie wave length of electron in this
orbit is
a) $\frac{2\pi r}{3}$ b) r/3 c) 3r d) 3(2πr)

11. In J.J Thomson experiment , a beam of electron is replaced by that of muons (particle with same charge as that of electrons but mass is 218 times that of electrons).No deflection condition is achieved by only if
(a). B is increased by 14.76 times (b) B is decreased by 208 times
(c) B is increased by 14.4 times (d) B is decreased by 14.4 times

12. The electric potential between a proton and an electron is given by V = $V_o \ln\left(\frac{r}{r_o}\right)$, where r_o is constant . Assume that Bohr atom model is applicable to potential , then variation of radius of n^{th} orbit r_n with the principle quantum number n is
(a) $r_n \alpha \frac{1}{n}$ (b) $r_n \alpha n$ (c) $r_n \alpha \frac{1}{n^2}$ (d) $r_n \alpha n^2$

13. e/m of the cathode ray particle depends on
a) nature of cathode b) nature of anode
c) nature of gas atoms in the tube d) none of these

14. The ratio of minimum to maximum wave length in Balmer series is
a) $\frac{4}{9}$ b) $\frac{5}{9}$ c) $\frac{7}{9}$ d) $\frac{8}{9}$

15. The first excitation potential energy or the minimum energy required to excite the atom from ground state of hydrogen atom is
a) 13.6 eV b) 10.2 eV c) 3.4 eV d) 1.89 eV

16. The ionisation Potential of hydrogen atom is 13.6 eV. An electron in the ground state absorbs Photon of energy 12.75 eV. How many different spectral lines can one expect when electron make a down ward transition
a) 1 b) 2 c) 6 d) 4

17. The ratio between the first three orbits of hydrogen atom is
(a) 1:2:3 (b) 2:4:6 (c) 1:4:9 (d) 1:3:5

18. In an hydrogen atom , the electron revolving in the fourth orbit has angular momentum equals to
(a) h (b) $\frac{h}{\pi}$ (c) $\frac{4h}{\pi}$ (d) $\frac{2h}{\pi}$

19.Suppose an alpha particle accelerated by a potential of V volt is allowed to collide with a nucleus whose atomic number is Z , then the distance of approach of alpha particle to the nucleus is
(a) $14.4\frac{Z}{V}$ Å (b) $14.4\frac{V}{Z}$ Å (c) $1.44\frac{Z}{V}$ Å (d) $1.44\frac{V}{Z}$ Å

20. The charge of cathode rays is
(a) positive (b) negative (c) neutral (d) not defined

II.Answer the following questions **5 × 2 = 10**

1. Give the results of Rutherford alpha scattering experiment.
2. Define the ionization energy and ionization potential.
3. Write down the draw backs of Bohr atom model.

4. What is distance of closest approach?
5. Define impact parameter.

III.Answer the following question **5 × 3 = 15**

1. Write down the postulates of Bohr atom model
2.Discuss the spectral series of hydrogen atom
3.Write down properties of cathode rays
4. Derive expression for Radius of the n^{th} orbit of the electron and velocity of the electron
5.What are the conclusions made by Rutherford after his scattering experiment?

IV.Answer the following questions **2 × 5 = 10**

1. Explain the J.J. Thomson experiment to determine the specific charge of electron
2.Using Bohr postulate derive the expression for total energy of electron in stationary orbits of hydrogen atom .Hence show that total energy in the stationary orbit in the ratio $1 : {}^{1}/_{4} : {}^{1}/_{9}$...........

V.Knowledge based questions **10 × 1 = 10**

1. When an electron falls from a higher energy to a lower energy level, the difference in the energies appears in the form of electromagnetic radiation. Why cannot it be emitted as other forms of energy?
2. Consider two different hydrogen atoms. The electron in each atom is in an excited state. Is it possible for the electrons to have different energies but the same orbital angular momentum according to the Bohr model?
3. Assume that there is no repulsive force between the electrons in an atom but the force between positive and negative charges is given by Coulomb's law as usual. Under such circumstances,calculate the ground state energy of a He-atom.
4. Using Bohr model, calculate the electric current created by the electron when the H-atom is in the ground state.
5. Suppose you are given a chance to repeat the alpha-particle scattering experiment using a thin sheet of solid hydrogen in place of the gold foil. (Hydrogen is a solid at temperatures below 14 K.) What results do you expect?
6. The ground state energy of hydrogen atom is -13.6 eV. What are the kinetic and potential energies of the electron in this state?
7. What is the shortest wavelength present in the Paschen series of spectral lines?
8. A difference of 2.3 eV separates two energy levels in an atom. What is the frequency of radiation emitted when the atom makes a transition from the upper level to the lower level?
9. Using the Bohr's model calculate the speed of the electron in a hydrogen atom in the $n = 1$ level.
10. Using the Bohr's model Calculate the orbital period in the $n = 1$ level.

If knowledge is not put into practice , it does not benefit one

Key

I.

1. (a) of the electrons not being subject to a central force.(Electron not being subjected to central force)
2. (a) in general to any of the states with lower energy.
3. (a) the electron would not move in circular orbits.
   (c) the electrons, orbit would go around the protons.
4. (a) will not be applicable to hydrogen in the molecular from.
   (b) will not be applicable as it is for a He-atom.
5. (b) if we measure the frequencies of light emitted due to transitions between excited states and the first excited state.
   (d) as a sequence of frequencies with the higher frequencies getting closely packed.
6. (c) He^4 has one more electron.
(d) electrons are not subject to central forces.
7.c) 1.5 x 10^7 ms^{-1} v = E/B
8. d)625000V/m E = V/d
9. a)$\frac{1}{R}$
10. a) $\frac{2\pi r}{3}$ $2\pi r = n\lambda$
11. (a). B is increased by 14.76 times
12. (b) $r_n \, \alpha \, n$
13d) none of these
14b) $\frac{5}{9}$
15. b) 10.2 eV
16. d) 4
17. (c)1:4:9
18. (d) $\frac{2h}{\pi}$
19.(c) $1.44\frac{Z}{V}$ Å
20. (b) negative

V

1.Electron can interact only electromagnetically
2.Given that electrons having different energies which means different n values .So angular momentum (mvr = nh/2π) differs.
3.The ground state will have two electrons and the total energy in ground state would be 2 × 13.6 eV
4.Number of revolutions per unit time .T = $\frac{2\pi a_o}{v}$ so current I = $\frac{2\pi a_o e}{v}$
5.In the alpha-particle scattering experiment, if a thin sheet of solid hydrogen is used in place of a gold foil, then the scattering angle would not be large enough. This is because the mass of hydrogen is less than the mass of incident α-particles . Thus, the mass of the scattering particle is more than the target nucleus (hydrogen). As a result, the α-particles would not bounce back if solid hydrogen is used in the α-particle scattering experiment.
6. E = -13.6 eV We know that K.E = - E So K.E = 13.6 eV
Potential energy is equal to the negative of two times of kinetic energy P.E = -27.2 Ev
7. n = 3 m = ∞ 818.9 nm
8.E = 2.3 × 1.6 × 10^{-19} J
E = hυ
υ = 5.6 × 10^{14} Hz
9.Using velocity relation for nth orbit v = 1.09 × 10^6 m/s
10.T = $\frac{2\pi r}{v}$ using above v value T = 1.527 × 10^{-16}