DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 1

Topic :-Atoms

1 **(b)**

As $E_1 > E_2$

$\therefore$ $v_1 > v_2$

ie, photon oh higher frequency will be emitted if transition takes place from n=2 to n=1.

2 **(b)**

Radius of Bohr orbit is given by

$$r_n = \left(\frac{\varepsilon_0 h^2}{\pi m e^2}\right) n^2$$

The quantities in the bracket are constant

$\therefore$ $r_n \propto n^2$

The expression gives the radius of the nth Bohr orbit

$$\frac{r_1}{r_2} = \frac{n_1^2}{n_2^2}$$

$$\frac{a}{r_2} = \frac{1}{3^2}$$

$$r_2 = 9\,a$$

3 **(b)**

The energy taken by hydrogen atom corresponds to its transition from

n =1 to n = 3 state.

ΔE (given to hydrogen atom)

$$= 13.6\left(1 - \frac{1}{9}\right)$$

$$=13.6 \times \frac{8}{9} = 12.1 \text{ eV}$$

4 **(b)**

Energy released $= E_4 - E_1$

$$= -\frac{13.6}{4^2} - \left(-\frac{13.6}{1^2}\right) = 1.75\text{eV}$$

5 **(c)**

The excitation energy in the first excited state is

$$E = RhcZ^2\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = (13.6 \text{ eV}) \times Z^2 \times \frac{3}{4}$$

$\therefore$ $40.8 = 13.6 \times Z^2 \times \frac{3}{4}$

$\Rightarrow$ $Z = 2$

So, the ion in problem is He^+. The energy of the ion in the ground state is

$$E = \frac{RhcZ^2}{1^2} = 13.6 \times 4 = 54.4 \text{ eV}$$

Hence, 54.4 eV is required to remove the electron from the ion.

6 **(b)**

Ultraviolet region	Lyman series
Visible region	Balmer series
Infrared region	Paschen series, Brackett series
	Pfund series

From the above chart it is clear that Balmer series lies in the visible region of the electromagnetic spectrum.

7 **(b)**

At distance of closest approach relative velocity of two particles is v. Here target is considered as stationary, so α-particle comes to rest instantaneously at distance of closest approach. Let required distance is r, then from work energy-theorem.

$$0 - \frac{mv^2}{2} = -\frac{1}{4\pi\varepsilon_0}\frac{Z_e \times Z_e}{r}$$

$$\text{r} \propto \frac{1}{m}$$

$$\propto \frac{1}{v^2}$$

$$\propto Ze^2$$

8 **(a)**

As $r \propto n^2$, therefore, radius of 2nd Bohr's orbit $= 4a_0$

9 **(b)**

$$\text{KE} = \frac{1}{2}\frac{e^2}{r}$$

10 **(a)**

$$E = -Z^2\frac{13.6}{n^2}\text{ eV}$$

For first excited state,

$$E_2 = -3^2 \times \frac{13.6}{4}$$

$$= -30.6 \text{ eV}$$

Ionisation energy for first excited state of Li^{2+} is 30.6 eV.

11 **(a)**

For maximum wavelength of Balmer series

$$\frac{1}{\lambda_{\max}} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = \frac{R \times 5}{36} \qquad \text{...(i)}$$

For minimum wavelength of Balmer series,

$$\frac{1}{\lambda_{\min}} = R\left(\frac{1}{2^2} - \frac{1}{\infty}\right) = \frac{R}{4} \qquad \text{...(ii)}$$

From Eqs.(i)and (ii), we have

$$\therefore \quad \frac{\lambda_{\min}}{\lambda_{\max}} = \frac{R \times 5}{36} \times \frac{4}{R} = \frac{5}{9}$$

12 **(a)**

Frequency, $v = RC\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$$v_1 = RC\left[1 - \frac{1}{\infty}\right] = RC$$

$$v_2 = RC\left[1 - \frac{1}{4}\right] = \frac{3}{4}RC$$

$$v_3 = RC\left[\frac{1}{4} - \frac{1}{\infty}\right] = \frac{RC}{4}$$

$$\Rightarrow \quad v_1 - v_2 = v_3$$

13 **(b)**

Time period of electron, $T = \frac{4\varepsilon_0^2 n^3 h^3}{mZ^2 e^4}$

$$\therefore \quad T \propto n^3$$

$$\therefore \quad \frac{1}{\text{frequency } (f)} \propto n^3$$

or $\quad f \propto n^{-3}$

14 **(a)**

$$E = E_2 - E_1 = -\frac{13.6}{2^2} - \left(-\frac{13.6}{1^2}\right) = 10.2 \text{ eV}$$

15 **(a)**

$$\frac{1}{\lambda_{\min}} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{R \times 5}{36}$$

$$\frac{1}{\lambda_{\max}} = R\left[\frac{1}{2^2} - \frac{1}{\infty}\right] = \frac{R}{4}$$

$$\frac{\lambda_{\min}}{\lambda_{\max}} = \frac{R \times 5}{36} \times \frac{4}{R} = \frac{5}{9}$$

16 **(d)**

Radius of orbit of electron in nth excited state of hydrogen

$$r = \frac{\varepsilon_0 h^2 n^2}{\pi m Z e^2}$$

$\therefore \quad r \propto \frac{n^2}{Z} \quad$ ...(i)

$\therefore \quad \frac{r_1}{r_2} = \frac{n_1^2}{n_2^2} \times \frac{Z_2}{Z_1}$

But $\quad r_1 = r_2$

So, $\quad n_2^2 = n_1^2 \times \frac{Z_2}{Z_1}$

Here,

$n_1 = 1$(ground state of hydrogen),

$Z_1 = 1$(atomic number of hydrogen),

$Z_2 = 4$(atomic number of beryllium)

$\therefore \quad \sqrt{n_2^2} = (1)^2 \times \frac{4}{1}$

or $\quad n_2^2 = 4$

or $\quad n_2 = 2$

17 **(a)**

For spin-orbit interaction, only the case of $l \geq 1$ is important since spin orbit interaction vanishes for l=0.

19 **(b)**

Hydrogen atom normally stays in lowest energy state (n=1), where its energy is

$$E_1 = \frac{Rhc}{1^2} = -Rhc$$

On being ionized its energy becomes zero. Thus, ionization of hydrogen atom is

$= $ energy after ionisation – energy before ionisation

$= 0 - (-Rhc) = Rhc$

$= (1.097 \times 10^7 \text{ m}^{-1})(6.63 \times 10 - 34 \text{ J} - \text{s})(3 \times 108 \text{ ms}^{-1})$

$= 21.8 \times 10^{-19}$ J

$= \frac{21.8 \times 10^{-19}}{1.6 \times 10^{-19}} = 13.6$ eV

20 **(d)**

In ground state TE$= -13.6$ eV

In first excited state, TE$= -3.4$ eV, *ie*,

10.2 eV above the ground state.

If ground state energy is taken as zero, the total energy in

First excited state $= 10.2$ eV

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	B	B	B	B	C	B	B	A	B	A
Q.	11	12	13	14	15	16	17	18	19	20
A.	A	A	B	A	A	D	A	D	B	D