DPP
DAILY PRACTICE PROBLEMS

CLASS : XIITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 5

Topic :-Atoms

1 **(b)**

Energy of electron in nth energy level in hydrogen atom

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

Here, $\frac{-13.6}{n^2} = -3.4$ eV

So, $n=2$

Angular momentum from Bohr's principle

$$= n\frac{h}{2\pi} = \frac{2 \times 6.626 \times 10^{-34}}{2 \times 3.14}$$

$$= 2.11 \times 10^{-34}\text{ Js}$$

2 **(b)**

The series in U-V region is Lyman series. Longest wavelength corresponds to, minimum energy which occurs in transition from n=2 to n=1.

$$\therefore \quad 122 = \frac{\frac{1}{R}}{\left(\frac{1}{1^2} - \frac{1}{2^2}\right)} \quad \text{...(i)}$$

The smallest wavelength in the infrared region corresponds to maximum energy of Paschen series.

$$\therefore \quad \lambda = \frac{\frac{1}{R}}{\left(\frac{1}{3^2} - \frac{1}{\infty}\right)} \quad \text{...(ii)}$$

Solving Eqs.(i) and (ii) , we get

$$\lambda = 823.5 \text{ nm}$$

3 **(d)**

For first line of Lyman series,

n_1=1 and n_2=2

$$\therefore \quad \frac{1}{\lambda_1} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = R\left(1 - \frac{1}{4}\right) = \frac{3R}{4}$$

For first line of Paschen Series

n_1=3 and n_2=4

$$\therefore \quad \frac{1}{\lambda_2} = R\left(\frac{1}{3^2} - \frac{1}{4^2}\right) = R\left(\frac{1}{9} - \frac{1}{16}\right) = \frac{7R}{144}$$

$$\therefore \quad \frac{\lambda_1}{\lambda_2} = \frac{7R}{144} \times \frac{4}{3R} = \frac{7}{108}$$

4 **(c)**

The wavelength of different members of Balmer series are given by

$$\frac{1}{\lambda} = R_{\mathrm{H}}\left[\frac{1}{2^2} - \frac{1}{n_i^2}\right], \text{ where } n_i = 3,4,5,....$$

The first member of Balmer series (H_α) corresponds to n_i=3.It has maximum energy and hence the longest wavelength. Therefore ,wavelength of H_α line (or longest wavelength)

$$\frac{1}{\lambda_1} = R_{\mathrm{H}}\left[\frac{1}{2^2} - \frac{1}{3^2}\right]$$

$$= 1.097 \times 10^7\left(\frac{5}{36}\right)$$

or $\quad \lambda_1 = \frac{36}{5 \times 1.097 \times 10^7} = 6.563 \times 10^{-7}$ m

$n = 6563$ Å

The wavelength of the Balmer series limit corresponds to $n_i = \infty$ and has got shortest wavelength.

Therefore , wavelength of Balmer series limit is given by

$$\frac{1}{\lambda_\infty} = R_{\mathrm{H}}\left[\frac{1}{2^2} - \frac{1}{\infty^2}\right] = 1.097 \times 10^7 \times \frac{1}{4}$$

or $\quad \lambda_\infty = \frac{4}{1.097 \times 10^7} = 3.646 \times 10^{-7}$ m

$= 3646$Å

Only 4861 Å is between the first and last line of the Balmer series.

5 **(a)**

Incandescent electric lamp produces continuous emission spectrum whereas mercury and sodium vapour give line emission spectrum. Polyatomic substances such as H_2, CO_2 and $KMnO_4$ produces band absorption spectrum.

6 **(c)**

The potential energy of hydrogen atom

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

So, the potential energy in second orbit is

$$E_2 = -\frac{13.6}{2^2} \text{ eV}$$

$$E_2 = -\frac{13.6}{4} \text{ eV} = -3.4 \text{ eV}$$

Now, the energy required to remove an electron from second orbit to infinity is

$U = E_\infty - E_2$ [From work-energy theorem and $E_\infty = 0$]

$\Rightarrow \quad U = 0 - (-3.4)$ eV

Or $\quad U = 3.4$ eV

Hence, the required energy is 3.4 eV.

7 **(c)**

Current , $I = 6.6 \times 10^{15} \times 1.6 \times 10^{-19}$

$= 10.5 \times 10^{-4}$ A

Area $A = \pi R^2 = 3.142 \times (0.528)^2 \times 10^{-20}\ m^2$

So, magnetic moment $M = IA = 10.5 \times 10^{-4} \times 3.142$

$\times (0.528)^2 \times 10^{-20}$

$= 10 \times 10^{-24} = 10^{-23}$ units

8 **(c)**

For Pfund series, $\frac{1}{\lambda_s} = R\left(\frac{1}{5^2} - \frac{1}{(\infty)^2}\right) = \frac{R}{25}$

$\lambda_s = 25/R$

$$\frac{1}{\lambda_l} = R\left(\frac{1}{5^2} - \frac{1}{6^2}\right) = R\left(\frac{36-25}{25 \times 36}\right)$$

$$\lambda_l = \frac{25 \times 36}{11R}$$

$$\therefore \frac{\lambda_l}{\lambda_s} = \frac{25 \times 36}{11R} \times \frac{R}{25}$$

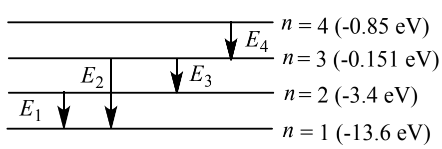
$$= \frac{36}{11}$$

9 **(d)**

$$\frac{R_1}{R_2} = \frac{n_1^2}{n_2^2} = \frac{1}{4} \therefore \frac{n_1}{n_2} = \frac{1}{2}$$

$$\frac{T_1}{T_2} = \left(\frac{n_1}{n_2}\right)^3 = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$$

10 **(d)**



$E_1 = -13.6 - (-3.4) = -10.2$ eV

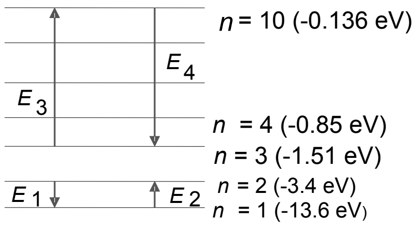
$E_2 = -13.6 - (-1.51) = -12.09$ eV

$E_3 = -3.4 - (-1.5) = -1.89$ eV

$E_4 = -1.51 - (-0.85) = -0.66$ eV

E_4 is least *ie*, frequency is lowest.

12 **(b)**



$E_1 =$ - 13.6 –(− 3.4) = − 10.2 eV

$E_2 =$ - 3.4 – (− 13.6) = + 10.2 eV

$E_3 =$ − 0.136 – (− 1.51) = − 1.374 eV

$E_4 =$ - 1.51 – (− 0.136) = − 1.374 eV

When an electron makes transition from higher energy level having energy $E_2(n_2)$ to lower energy level having energy$E_1(n_1)$, then a photon of frequency v is emitted.

Here, for emission line E_1 is maximum hence, it will have the highest frequency emission line.

13 **(c)**

From $mvr = \frac{nh}{2\pi}$

$$v = \frac{nh}{2\pi mr}$$

Acceleration, $a = \frac{v^2}{r} = \frac{n^2h^2}{4\pi^2m^2r^3}$

$$= \frac{h^2}{4\pi^2m^2r^3} \qquad (n = 1)$$

14 **(c)**

$\lambda \propto n^2$

$\therefore \quad \frac{\lambda_{\text{Lyman}}}{\lambda_{\text{Balmer}}} = \left(\frac{1}{2}\right)^2 = \frac{1}{4} = 0.25$

15 **(b)**

The minimum energy needed to ionise an atom is called ionisation energy. The potential difference through which an electron should be accelerated to acquire this much energy is called ionisation potential.

$$(E_2)_H - (E_1)_H = 10.2 \text{ eV}$$

or $\frac{(E_1)_H}{4} - (E_1)_H = 10.2$ eV

$\therefore \quad (E_1)_H = -13.6$ eV

Hence ,ionisation potential energy is

$= (E_\infty)_H - (E_1)_H = 13.6$ eV

$\therefore$ Ionisation potential = 13.6 V

16 **(c)**

As $U = 2E, K = -E$

Also, $E = -\frac{13.6}{n^2}$ eV

Hence, K and U change as four fold each.

17 **(c)**

The energy of first excitation of sodium is

$$E = hv = \frac{hc}{\lambda}$$

Where h is Planck's constants, v is frequency, c is speed of light and λ is wavelength.

$$E = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{5896 \times 10^{-10}}$$

$$E = 3.37 \times 10^{-19}\text{ J}$$

Also since $1.6 \times 10^{-19}\text{ J} = 1\text{eV}$

$$\therefore \quad E = \frac{3.37 \times 10^{-19}}{1.6 \times 10^{-19}}\text{ eV}$$

$$E = 2.1\text{ eV}$$

Hence ,corresponding first excitation potential is 2.1 V.

18 **(b)**

The radius of the orbit of the electron in the nth excited state

$$r_e = \frac{n^2 4\pi\varepsilon_0 h^2}{4\pi^2 mZe^2}$$

For the first excited state

$$n = 2, Z = 1$$

$$\because \quad r' = \frac{4\varepsilon_0 h^2}{\pi me^2}$$

For the ground state of hydrogen atom

$$n = 1, Z = 1$$

$$\because \quad r'' = \frac{h^2\varepsilon_0}{\pi me^2}$$

The ratio of radius

$$\frac{r'}{r''} = \frac{4}{1}$$

The ratio of area of the electron orbit for hydrogen atom

$$\frac{A'}{A''} = \frac{4\pi(r')^2}{4\pi(r'')^2}$$

$$\frac{A'}{A''} = \frac{16}{1}$$

19 **(d)**

Kinetic energy of electron

$$K = \frac{Ze^2}{8\pi\varepsilon_0 r}$$

Potential energy of electron

$$U = \frac{1}{4\pi\varepsilon_0 r}\frac{Ze^2}{r}$$

$\therefore$ Total energy

$E = K + U = \frac{Ze^2}{8\pi\varepsilon_0 r} - \frac{Ze^2}{4\pi\varepsilon_0 r}$

Or $E = \frac{Ze^2}{8\pi\varepsilon_0 r}$

Or $E = -K$

Or $K = -E = -(-3.4)$

Or $= 3.4$ eV

20 **(d)**

As is known,

PE = $-$2KE

$ie,\ E_P = -2E_K$ or $\frac{E_p}{E_k} = -2$

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