DPP
DAILY PRACTICE PROBLEMS

CLASS : XIITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 4

Topic :-Atoms

1 **(a)**

According to Bohr's theory of hydrogen atom , angular momentum is quantized *ie*,

$$L = mv_n r_n = n\left(\frac{h}{2\pi}\right)$$

Or $L \propto n$

Radius of the orbit $r_n \propto \frac{n^2}{Z}$

Kinetic Energy $= \frac{kZ^2e^2}{2n^2}$ $ie, k \propto \frac{1}{n^2}$

2 **(a)**

Number of possible elements

$= 2(1^2 + 2^2 + 3^2 + 4^2)$

$= 2(1 + 4 + 9 + 16) = 60$

3 **(a)**

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

$$\therefore r_0 = \frac{1}{2}a_0$$

As $E \propto m$

$\therefore E_0 = 2(-13.6) = -27.2$ eV

4 **(a)**

$$U = eV = eV_0 \ln\left(\frac{r}{r_0}\right)$$

$$\therefore \quad |F| = \left|-\frac{dU}{dr}\right| = \frac{eV_0}{r}$$

This force will provide the necessary centripetal force. Hence

$$\frac{mv^2}{r} = \frac{eV_0}{r}$$

or $v = \sqrt{\frac{eV_0}{m}}$ ....(i)

Moreover

$$mvr = \frac{nh}{2\pi} \quad .....(ii)$$

Dividing Eq. (ii) by Eq. (i), we have

$$mr = \left(\frac{nh}{2\pi}\right)\sqrt{\frac{m}{eV_0}}$$

Or $r_n \propto n$

5 **(a)**

Linear momentum = $mv = \frac{mcZ}{137\,n}$

Angular momentum = $\frac{nh}{2\,\pi}$

Given,

Linear momentum $\times$ angular momentum $\propto n^x$

$$\therefore \quad \frac{mcZ}{137\,n} \times \frac{nh}{2\pi} \propto n^x$$

$$n^0 \propto n^x$$

$$\Rightarrow \quad x = 0$$

6 **(c)**

Series limit of Balmer series is given by

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

$$R = \frac{4}{\lambda_{\min}} = \frac{4}{6400} = \frac{1}{1600}\text{Å}^{-1}$$

Series limit of Paschen series would be

$$\frac{1}{\lambda_{\min}} = R\left(\frac{1}{3^3} - \frac{1}{\infty}\right) = \frac{R}{9}$$

$$\lambda_{\min} = \frac{9}{R} = \frac{9}{1/1600} = 14400\text{Å}$$

7 **(a)**

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

8 **(d)**

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

Energy of photon ejected when electron jumps from n=3 state to n=2 state is given by

$\Delta E = E_3 - E_2$

$$\therefore \quad E_3 = -\frac{13.6}{(3)^2}\text{ eV} = -\frac{13.6}{9}\text{ eV}$$

$$E_2 = -\frac{13.6}{(2)^2}\text{ eV} = -\frac{13.6}{4}\text{ eV}$$

So, $\Delta E = E_3 - E_2 = -\frac{13.6}{9} - \left(-\frac{13.6}{4}\right)$

$= 1.9$ eV (approximately)

9 **(c)**

Centripetal force=force of attraction of nucleus on electron

$$\frac{mv^2}{a_0} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{a_0^2}$$

$$v = \frac{e}{\sqrt{4\pi\varepsilon_0 m a_0}}$$

10 **(c)**

From $mvr = \frac{n\text{h}}{2\pi}, v = \frac{n\text{h}}{2\pi mr}$

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

11 **(d)**

In the first case, energy emitted,

$E_1 = 2E - E = E$

In the second case, energy emitted

$$E_2 = \frac{4E}{3} - E = \frac{E}{3}$$

As E_3 is $\frac{1}{3}$ rd, $\lambda_2$must be 3 times, *ie*,3λ

12 **(d)**

$E = E_1/n^2$

Energy used for excitation is 12.75 eV

ie, $(-13.6 + 12.75)$ eV $= -0.85$ eV

Energy levels of H-atom

The photon of energy 12.75 eV can excite the fourth level of H-atom

Therefore, six lines will be emitted.

$\left(n\frac{(n-1)}{2}\text{ lines}\right)$.

13 **(c)**

$$\frac{\lambda_l}{\lambda_s}=\frac{R\left(\frac{1}{1^2}-\frac{1}{\infty}\right)}{R\left(\frac{1}{1^2}-\frac{1}{2^2}\right)}=\frac{4}{3}$$

$$\lambda_l=\frac{4}{3}\lambda_s=\frac{4}{3}\times 911.6=1215.4\ \text{Å}$$

14 **(a)**

For Lyman series, $n_1=1, n_2=\infty$

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

15 **(b)**

The series end of Lyman series corresponds to transition from $n_i=\infty$ to $n_f=1$, corresponding to the wavelength

$$\frac{1}{(\lambda_{\min})_L}=R\left[\frac{1}{1}-\frac{1}{\infty}\right]=R$$

$\Rightarrow \quad (\lambda_{\min})_L=\frac{1}{R}=912\ \text{Å} \qquad$ ...(i)

For last line of Balmer series

$$\frac{1}{(\lambda_{\min})_B}=R\left[\frac{1}{(2)^2}-\frac{1}{(\infty)^2}\right]=\frac{R}{4}$$

$\Rightarrow \quad (\lambda_{\min})_B=\frac{4}{R}=3636\ \text{Å} \qquad$ ...(ii)

Dividing Eq.(i) by Eq. (ii) .we get

$$\frac{(\lambda_{\min})_L}{(\lambda_{\min})_B}=0.25$$

16 **(a)**

Frequency of revolution of electron,

$$f=\frac{v}{2\pi r}=\frac{2.2\times 10^6}{2\pi(5\times 10^{-11})}=7.0\times 10^{15}\ \text{Hz}$$

Current associated, $i=q\,f$

$$=(1.6\times 10^{-19})(7.0\times 10^{15})$$

$$=11.2\times 10^{-4}\ \text{A}=1.12\ \text{mA}$$

17 **(d)**

$$(r_m)=\left(\frac{m^2}{z}\right)(0.53\text{Å})=(n\times 0.3)\text{Å}$$

$$\therefore \qquad \frac{m^2}{z}=n$$

m=5 for ${}_{100}\text{Fm}^{257}$ (the outermost shell) and $z=100$

$\therefore \qquad n = \frac{(5)^2}{100} = \frac{1}{4}$

18 **(a)**

$$\frac{1}{\lambda_{\text{max}}} = R\left[\frac{1}{(1)^2} - \frac{1}{(2)^2}\right]$$

$\Rightarrow \quad \lambda_{\text{max}} = \frac{4}{3R} \approx 1213\ \text{Å}$

and $\frac{1}{\lambda_{\text{min}}} = R\left[\frac{1}{(1)^2} - \frac{1}{\infty}\right]$

$\Rightarrow \quad \lambda_{\text{min}} = \frac{1}{R} \approx 910\ \text{Å}$

19 **(b)**

Given, $v = 2.18 \times 10^6\ \text{ms}^{-1}, r = 0.528 \times 10^{-10}\text{m}$

Acceleration of electron moving round the nucleus

$$a = \frac{(2.18 \times 10^6)^2}{0.528 \times 10^{-10}} \approx 9 \times 10^{22}\ \text{ms}^{-2}$$

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