DPP

DAILY PRACTICE PROBLEMS

CLASS : XIITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 6

Topic :-Atoms

1 **(b)**

For Balmer series, n_f =2 and n_i=3,4,5,….

Frequency, of 1st spectral line of Balmer series

$$f = RZ^2 c\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

or $$f = RZ^2 c \times \frac{5}{36} \quad ...(i)$$

Frequency, of 2nd spectral line of Balmer series

$$f' = RZ^2 c\left(\frac{1}{2^2} - \frac{1}{4^2}\right)$$

or $$f' = RZ^2 c \times \frac{3}{16} \quad ....(ii)$$

Form eqs. (i) and (ii), we have

$$\frac{f}{f'} = \frac{20}{27}$$

$$\therefore \; f' = \frac{27}{20} f = 1.35 f$$

2 **(d)**

Let a particle of change q having velocity v approaches Q upto a closest distance r and if the velocity becomes $2v$, the closest distance will be $r.'$

The law of conservation of energy yields,

Kinetic energy of particle=electric potential energy between them at closest distance of approach.

Or $$\frac{1}{2}mv^2 = \frac{1}{4\pi\varepsilon_0}\frac{Q_q}{r}$$

Or $$\frac{1}{2}mv^2 = k\frac{Qq}{r} \quad ...(i)$$

$$\left(\text{k} = \text{constant} = \frac{1}{4\pi\varepsilon_0}\right)$$

and $$\frac{1}{2}m(2v)^2 = k\frac{Qq}{r'} \quad ...(ii)$$

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

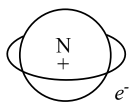
$$\frac{\frac{1}{2}mv^2}{\frac{1}{2}m(2v)^2} = \frac{\frac{kQq}{r}}{\frac{kQq}{r'}}$$

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

$\Rightarrow \quad r' = \frac{r}{4}$

3 **(a)**

The positively charged nucleus, has electrons revolving around it in stationary orbits. The Coulomb's force provides the necessary centripetal force attraction to keep the electrons is orbits.



4 **(a)**

Wavelength emitted (λ)is given by

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = \frac{5R}{36}$$

$$\lambda = \frac{36}{5R}$$

5 **(d)**

Infrared radiation corresponds to least value of $\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$,*ie*, from Paschen, Brackett and Pfund series. Thus the transition corresponds to 5 →3.

6 **(c)**

In hydrogen atom, $E_n = \frac{R\text{h}c}{n^2}$

Also, $E_n \propto m$, where m is the mass of the electron. Here, the electron has been replaced by a particle, whose mass is double the mass of an electron. Therefore, this hypothetical atom, energy is nth orbit will be given by

$$E_n = -\frac{2R\text{h}c}{n^2}$$

The longest wavelength (or minimum energy) photon will correspond to the transition of particle from $n = 3$to $n = 2$

$$\Rightarrow \frac{\text{h}c}{\lambda_{\max}} = E_3 - E_2 = 2R\text{h}c\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = 2R\text{h}c \times \frac{5}{36}$$

$$\therefore \lambda_{\max} = \frac{\text{h}c}{\frac{5}{18}R\text{h}c} = \frac{18}{5R}$$

7 **(c)**

For Balmer series, n_1 - 2, $n_2 = 3$ for 1st line and $n_2 = 4$ for second line

$$\frac{\lambda_1}{\lambda_2} = \left(\frac{\frac{1}{2^2} - \frac{1}{4^2}}{\frac{1}{2^2} - \frac{1}{3^2}}\right) = \frac{3/16}{5/16} = \frac{3}{16} \times \frac{36}{5} = \frac{27}{20}$$

$$\lambda_2 = \frac{20}{27}\lambda_1 = \frac{20}{27} \times 6561 = 4860 \text{ Å}$$

8 **(b)**

Number of spectral lines $= \frac{n(n-1)}{2} = \frac{3(3-1)}{2} = 3$

9 **(b)**

No. of neutrons in $C^{12} = 12 - 6 = 6$

No. of electrons in $C^{14} = 14 - 6 = 8$

10 **(c)**

Energy of helium ions.

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

In minimum position, n=1

For He^+, $Z = 2$

$$E = \frac{-13.6 \times (2)^2}{1} \text{ eV}$$

$$E = 54.4 \text{ eV}$$

11 **(a)**

Radius of orbit

$$r_n = \frac{n^2 h^2}{4\pi^2 k^2 m_e^2}$$

$$r_n \propto n^2$$

Energy $\quad E = -Rch\frac{Z^2}{n^2}$

$$E \propto \frac{1}{n^2}$$

13 **(a)**

$$\frac{\lambda_B}{\lambda_L} = \frac{\left(\frac{1}{1^2} - \frac{1}{2^2}\right)}{\left(\frac{1}{2^2} - \frac{1}{3^2}\right)} = \frac{3/4}{5/36} = \frac{27}{5}$$

$$\lambda_L = \frac{5}{27}\lambda_B = \frac{5}{27} \times 6563 = 1215.4 \text{ Å}$$

14 **(b)**

Ionization energy corresponding to ionization potential

$$= -13.6 \text{ eV}$$

Photon energy incident $= 12.1$ eV

So,the energy of electron in excited state

$$= -13.6 + 12.1 = -1.5 \text{ eV}$$

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

$$-1.5 = -\frac{-13.6}{n^2}$$

$\Rightarrow$ $n^2 = \frac{-13.6}{-1.5} \approx 9$

$\therefore$ $n = 3$

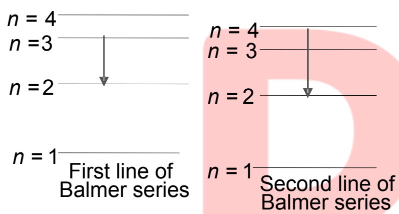
ie, energy of electron in excited state corresponds to third orbit.

The possible spectral lines are when electron jumps from orbit 3rd to 2nd; 3rd to 1st and 2nd to 1st. Thus, 3 spectral lines are emitted.

15 **(d)**

Solar Spectrum is an example of line absorption Spectrum.

16 **(a)**



For hydrogen or hydrogen type atoms

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

In the transition from $ni \rightarrow nf$

$$\therefore \quad \lambda \propto \frac{1}{Z^2\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)}$$

$$\therefore \quad \frac{\lambda_2}{\lambda_1} = \frac{Z_1^2\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)_1}{Z_2^2\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)_2}$$

$$\lambda_2 = \frac{\lambda_1 Z_1^2\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)_1}{Z_2^2\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)_2}$$

Substituting the values, we have

$$= \frac{(6561)(1)^2\left(\frac{1}{2^2} - \frac{1}{3^2}\right)}{(2)^2\left(\frac{1}{2^2} - \frac{1}{4^2}\right)} = 1215 \text{ Å}$$

17 **(d)**

$E = E_4 - E_3$

$= -\frac{13.6}{4^2} - \left(-\frac{13.6}{3^2}\right) = -0.85 + 1.51$

$= 0.66$ eV

18 **(d)**

Nucleus Contains only the neutrons and protons.

19 **(a)**

Number of emitted spectral lines

$$N = \frac{n(n-1)}{2}$$

Case I

$$N = 3$$

$\therefore$ $$3 = \frac{n_1(n_1 - 1)}{2}$$

$\Rightarrow$ $$n_1^2 - n_1 - 6 = 0$$

$$(n_1 - 3)(n_1 + 2) = 0$$

$$n_1 = 3$$

Case II

$$N = 6$$

$$6 = \frac{n_2(n_2 - 1)}{2}$$

$$n_2^2 - n_2 - 12 = 0$$

$\Rightarrow (n_2 - 4)(n_2 + 3) = 0$

$$n_2 = 4 , n_2 = -3$$

Again , as n_2 is always positive

$\therefore$ $$n_2 = 4$$

Velocity of electron $v = \frac{Ze^2}{2\varepsilon_0 h n}$

$\therefore$ $$\frac{v_1}{v_2} = \frac{n_2}{n_1}$$

$\Rightarrow$ $$\frac{v_1}{v_2} = \frac{4}{3}$$

20 **(c)**

According to the Bohr's theory the wavelength of radiations emitted from hydrogen atom given by

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

For maximum wavelength if $n_1 = n$, then $n_2 = n + 1$

$\therefore$ λ *is* maximum for $n_2 = 3$ and $n_1 = 2$.

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