# DPP

DAILY PRACTICE PROBLEMS

CLASS : XIITH
DATE :

**Solutions**

SUBJECT : PHYSICS
DPP NO. : 8

## Topic :-Atoms

1 **(a)**

When an atom comes down from some higher energy level to the second energy ($n$=2), then the lines of spectrum are obtained in visible part and give the Balmer series.

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right), n = 3,4,5,.....$$

For second line $n = 4$

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

$$\lambda = \frac{16}{3R}$$

$$R = 1.097 \times 10^7 \text{ m}^{-1}$$

$$\lambda = \frac{16}{3 \times 1.097 \times 10^7}$$

$$= 4860 \times 10^{-10} \text{ m}$$

$\Rightarrow \quad \lambda = 4860$ Å

which corresponds to colour blue.

2 **(c)**

$$r_0 = \frac{(Ze)(2e)}{4\pi\varepsilon_0(E)} = \frac{2 \times 92(1.6 \times 10^{-19})^2 \times 9 \times 10^9}{5 \times 1.6 \times 10^{-13}}$$

$$= 0.53 \times 10^{-14}\text{m} \approx 10^{-12}\text{cm}$$

3 **(b)**

Wavelength ($\lambda$) during transition from $n_2$ to $n_1$ is given by

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

$$\Rightarrow \frac{1}{\lambda_{3\to2}} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5R}{36}$$

and $\frac{1}{\lambda_{4\to2}} = r\left[\frac{1}{2^2} - \frac{1}{4^2}\right] = \frac{3R}{16}$

$$\therefore \quad \frac{\lambda_{4\to 2}}{\lambda_{3\to 2}} = \frac{20}{27}$$

$$\Rightarrow \lambda_{4\to 2} = \frac{20}{27}\lambda_0$$

4 **(c)**

As energy $\propto \frac{1}{\lambda}$,

Therefore, energy corresponding to 1 Å = 2.5 × 5000 eV

5 **(c)**

The energy of $n$th orbit of hydrogen like atom is,

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

Here, $Z = 11$ for Na atom. 10 electrons are removed already. For the last electron to be removed $n$=1.

$$\therefore E_n = \frac{-13.6 \times (11)^2}{(1)^2} \text{ eV}$$

$$= -13.6 \times (11)^2 \text{ Ev}$$

6 **(d)**

In Lyman series, wavelength emitted is given by

$$\frac{1}{\lambda} = R\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$$

where, $n$ =2,3,4……

and $R$ = Rydberg's constant

$$= 1.097 \times 10^7 \text{m}^{-1}$$

For maximum wavelength $n$=2

$$\therefore \quad \frac{1}{\lambda_{max}} = 1.097 \times 10^7\left[\frac{1}{1^2} - \frac{1}{2^2}\right]$$

$$\frac{1}{\lambda_{max}} = 1.097 \times 10^7\left[\frac{1}{1} - \frac{1}{4}\right]$$

$$= 1.097 \times 10^7 \times \frac{3}{4}$$

$$\Rightarrow \quad \lambda_{max} = \frac{4}{3.291 \times 10^7}$$

$$= 1216 \text{ Å} = 121.6 \text{ m}$$

$$\therefore \quad \lambda_{max} = 122\text{nm}$$

7 **(d)**

$$R = \frac{2\pi^2 mk^2 e^4}{ch^3} = \left(\frac{1}{4\pi\varepsilon_o}\right)^2 \frac{2\pi^2 me^4}{ch^3}$$

8 **(c)**

The first photon will excite the hydrogen atom (in ground state) in first excited state (as $E_2$ - $E_1$ - 10.2 eV). Hence, during de-excitation a photon of 10.2 eV will be released. The second photon of energy 15 eV can ionize the atom.
Hence the balance energy *ie*,
(15 — 13.6) eV = 1.4 eV is retained by the electron.
Therefore, by the second photon an electron of energy 1.4 eV will be released

9 **(b)**
The Kinetic energy of the electron in the $n$th state

$$K = \frac{mZ^2e^4}{8\varepsilon_0^2 h^2 n^2}$$

The total energy of the electron in the $n$th state

$$T = -\frac{mZ^2e^4}{8\varepsilon_0^2 h^2 n^2}$$

$$\therefore \quad \frac{K}{T} = -1$$

10 **(d)**

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

$n_1$=2, $n_2$=4

$$\frac{1}{\lambda} = R\left[\frac{1}{4} - \frac{1}{16}\right]$$

$$= R\left[\frac{4-1}{16}\right] = \frac{3R}{16}$$

$$\lambda = \frac{16}{3R}$$

11 **(c)**
1amu (or 1 u)=1.6 $\times$ $10^{-27}$ kg
40 u=40 $\times$ 1.6 $\times$ $10^{-27}$ kg
Number of atoms in earth

$$= \frac{6.64 \times 10^{24}}{40 \times 1.6 \times 10^{-27}} = 10^{50}$$

12 **(a)**
For minimum wavelength $n_2 = \infty$ , $n_1 = n$.

So, $\lambda_{\min} = \frac{n^2}{R} = \frac{1}{10^7} = 1000$ Å

13 **(c)**
From Hubble 's law

$$Z \propto r$$

Where $Z \rightarrow$ red shift, $r \rightarrow$distance of the galaxy

Also, $Z = \frac{d\lambda}{\lambda} = \frac{v}{c} = \frac{\text{speed of galaxy}}{\text{speed of light}}$

Given $d\lambda = 401.8 - 393.3 = 8.5$ nm,
$\lambda = 393.3$ nm,

$$Z = \frac{8.5}{393.3} = 0.0216$$

Also $v = cZ$

$= 3 \times 10^8 \times 0.0216$

$= 64.8 \times 10^5 \text{ms}^{-1}$

Since $1\text{km} = 10^3\text{m}$, therefore

$v = 6480 \text{ kms}^{-1}$

14 **(d)**

Lowest orbit is $n = 1$. Three lower orbits correspond to $n = 1. 2. 3$

$$\therefore E_1 = \frac{13.6}{1^2} = 13.6 \text{ eV},$$

$$E_2 = \frac{13.6}{2^2} = 3.4 \text{ eV}, E_3 = \frac{13.6}{3^2} = 1.5 \text{ eV}$$

15 **(a)**

$\therefore n = 5$

$$r_n = (0.53 \times 10^{-10}) \frac{n^2}{Z}$$

$$= \frac{0.53 \times 10^{-10} \times 5^2}{53} = 2.5 \times 10^{-11}\text{m}$$

16 **(a)**

Here, $n_f = 1, n_i = n$

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

$\Rightarrow$ $\frac{1}{\lambda} = R\left(1 - \frac{1}{n^2}\right)$ ..(i)

or $\frac{1}{\lambda R} = 1 - \frac{1}{n^2}$ or $\frac{1}{n^2} = 1 - \frac{1}{\lambda R}$

or $n = \sqrt{\frac{\lambda R}{\lambda R - 1}}$

17 **(b)**

Since spectrum of an oil flame consists of continuously varying wavelength in a definite wavelength range, it is an example for continuous emission spectrum.

18 **(c)**

It is difficult to excite nucleus by usual methods employed for excitation for atoms because difference in energy of allowed energy states for nucleus is of the order of tens to hundreds of MeV.

19 **(b)**

An alpha particle carries 2 units of positive charge and 4 units of mass. It is made up of protons and 2 neutrons which make a nucleus of helium *ie*, helium atom is a deoid of 2 electrons *ie*, doubly ionized helium atom.

20 **(b)**

1. If Assertion is True, Reason is True, Reason is correct explanation of 1
2. If Assertion is True, Reason is True, Reason is not correct explanation of 1
3. If Assertion is True, Reason is False
4. If Assertion is False, Reason is True

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