DPP
DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 9

Topic :- NUCLEI

1 **(b)**

Here $\frac{N}{N_0}=\left(\frac{1}{2}\right)^n=\left(\frac{1}{2}\right)^{1/3}$

Where $n=$ Number of half lives $=\frac{1}{3}$

$$\Rightarrow \frac{N}{N_0}=\frac{1}{1.26}\Rightarrow \frac{N_U}{N_{Pb}+N_U}=\frac{1}{1.26}$$

$$\Rightarrow N_{Pb}=0.26\ N_U\Rightarrow \frac{N_{Pb}}{N_U}=0.26$$

3 **(a)**

According to Rydberg's formula

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

Here, $n_f=1, n_i=n$

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

Multiplying equation (i) by λ on both sides,

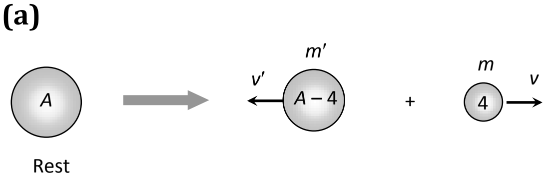
$$1=\lambda R\left(1-\frac{1}{n^2}\right)\Rightarrow \frac{1}{\lambda R}=1-\frac{1}{n^2}$$

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

4 **(c)**

Energy of stars is due to the fusion of light hydrogen nuclei into He. In this process much energy is released

5 **(a)**



According to conservation of momentum $4v=(A-4)v'$

$$\Rightarrow v'=\frac{4v}{A-4}$$

7 **(c)**

For third line of Balmer series $n_1 = 2, n_2 = 5$

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

On putting values $Z = 2$

From $E = -\frac{13.6Z^2}{n^2} = \frac{-13.6(2)^2}{(1)^2} = -54.4eV$

8 **(d)**

Using conservation of momentum $P_{daughter} = P_\alpha$

$\Rightarrow \frac{E_d}{E_\alpha} = \frac{m_\alpha}{m_d} \Rightarrow E_d = \frac{E_\alpha \times m_\alpha}{m_d} = \frac{6.7 \times 4}{214} = 0.125MeV$

9 **(d)**

$B.E.$ per nucleon $\propto$ stability

10 **(a)**

According to Bohr theory, $mvr = n\frac{h}{2\pi} \Rightarrow v = \frac{nh}{2\pi mr}$

and $\frac{mv^2}{r} \propto \frac{k}{r} \Rightarrow \frac{m}{r}\left(\frac{n^2h^2}{4\pi^2m^2r^2}\right) \propto \frac{k}{r} \Rightarrow r_n \propto n$

Kinetic energy $T = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\frac{n^2h^2}{4\pi^2m^2r^2}\right) \Rightarrow T_n \propto \frac{n^2}{r^2}$

But as $r \propto n$ therefore $T \propto n^0$

11 **(a)**

For Lyman series $v = RC\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$

Where $n = 2, 3, 4, \ldots\ldots$

For the series limit of Lyman series $n = \infty$

$\therefore v_1 = RC\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right] = RC$ ...(i)

For the first line of Lyman series, $n = 2$

$\therefore v_2 = RC\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3}{4}RC$ ...(ii)

For Balmer series $v = RC\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$

Where $n = 3, 4, 5 \ldots$

For the series limit of Balmer series $n = \infty$

$\therefore v_3 = RC\left[\frac{1}{2^2} - \frac{1}{\infty^2}\right] = \frac{RC}{4}$ ...(iii)

From equations (i), (ii) and (iii), we get

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

12 **(b)**

Positron is the antiparticle of electron

13 **(d)**

Nuclides with same atomic number Z but different mass number A are known as isotopes
Nuclides with same mass number A but different atomic number Z are known as isobars
Nuclides with same neutron number $N = (A - Z)$ but different atomic number Z are known as isotones

${}_1H^2$ and ${}_1H^3$ are isotopes

${}_2He^3$ and ${}_1H^3$ are isobars

${}_{79}Au^{197}$ and ${}_{80}Hg^{198}$ are isotones

14 **(b)**

${}_6C^{12} + {}_0n^1 \rightarrow {}_7N^{13} + {}_{-1}e^0 + \bar{v}$

(Neutron) (Beta particle) (Anti neutrino)

On equating atomic numbers and atomic masses, the atomic number and atomic mass for resulting nucleus is 7 and 13, which is for nitrogen nucleus.

15 **(d)**

$$E = \Delta mc^2 \Rightarrow E = \frac{0.3}{1000} \times (3 \times 10^8)^2 = 2.7 \times 10^{13} J$$

$$= \frac{2.7 \times 10^{13}}{3.6 \times 10^6} = 7.5 \times 10^6 kWh$$

16 **(d)**

The number force is charge independent

No. of nucleons = No. of protons + no. of neutrons = Mass number

All nuclei have masses that are less than the sum of the masses of its constituents. The difference in mass of a nucleus and its constituents is known as mass defect.

Nucleons belong to the family of hadrons while electrons belong to family of leptons

18 **(a)**

Given $N_0\lambda = 5000$, $N\lambda = 1250$

$$N = N_0 e^{-\lambda t} = N_0 e^{-5\lambda}$$

Where λ is decay constant per min.

$$N\lambda = N_0 \lambda e^{-5\lambda}$$

$$1250 = N_0 \lambda e^{-5\lambda}$$

$$\therefore \quad e^{-5\lambda} = \frac{5000}{1250} = 4$$

$$e^{5\lambda} = 4$$

$$5\lambda = 2\log_e 2$$

$$\lambda = 0.4 \ln 2$$

19 **(d)**

β-emission takes place from a radioactive nucleus as

$${}^{32}_{15}P \xrightarrow{-\beta} {}^{32}_{16}S + {}_{-1}e^0 + \bar{v}_1$$

Where $\bar{v}$ is the anti-neutrino.

In β^+ decay a positron is emitted as

$${}^{22}_{11}Na \rightarrow {}^{22}_{10}Ne + {}_{-1}e^0 + v$$

20 **(a)**

Excitation energy $\Delta E = E_2 - E_1 = 13.6\, Z^2 \left[\frac{1}{1^2} - \frac{1}{2^2}\right]$

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

Now required energy to remove the electron from ground state $= \frac{+13.6 Z^2}{(1)^2} = 13.6 (Z)^2$

$$= 54.4\ eV$$

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