AVIRAL
JEE | NEET | FOUNDATIONS

WEEKLY TEST OYJ TEST - 27 R & B SOLUTION Date 10-11-2019

[PHYSICS]

1. (c)

2. $$\frac{1}{\lambda}=Z^2R\left[\frac{1}{n_f^2}-\frac{1}{n_i^2}\right]$$

For first line of Lyman series,

$n_i=2, n_f=1, R=10967800\ m^{-1}$ $Z=11$

$$\frac{1}{\lambda}=(11)^2(1.09678\times10^7)\times\left[\frac{1}{1^2}-\frac{1}{2^2}\right]$$

$$\therefore \quad \lambda=\frac{1216}{(11)^2}Å.$$

3. (b)
4. When an electron makes a transition from any higher level to n = 1 level, ultraviolet light is emitted. When an electron jumps from any higher level to n = 2 level, visible light is emitted. X-rays are emitted when one of the electrons frome some inner shell of the atom is knocked out and the vacancy, so created is filled up by jumping of the electron from the higher energy shell. On the other hand,
γ-rays emitted from the nucleus of an atom.
5. (a)
6. (a)
7. We know that n gives the average distance of an electron from nucleus and corresponds to the principal energy level to which energy belongs *l* determines the shape of the orbital and the energy associated with the angular momentum of the electron. Therefore, energy of an electron is decided by n and *l*.

8. In two half-lives, the material that remains undecayed is $\frac{1}{4}$th, *i.e.*, 25%. Hence, percentage of decayed material = 75 %.

9. $T_h = 1600$ years

$$T_m=\frac{T_h}{0.693}=\frac{1600}{0.693}\text{ years}=2309\text{ years}$$

$$\lambda=\frac{1}{T_m}=\frac{1}{2309}\text{ per year.}$$

10. Decaying fraction = 3/4

Surviving fraction $= 1 - \frac{3}{4} = \frac{1}{4}$

But, $\frac{N}{N_0} = \frac{1}{4} = \left(\frac{1}{2}\right)^n$

Hence, $n = 2$

As $t/T = n = 2$ and $T = 4$ months

$\therefore$ $t = 8$ months.

11. $$\frac{N}{N_0} = \frac{1}{20} = \left(\frac{1}{2}\right)^n$$

So, n lies between 4 and 5. t lies between $4T$ and $5T$, *i.e.*, t lies between 4×3.8 days and 5×3.8 days, *i.e.*, t lies between 15.2 days and 19.0 days. Hence, $t = 16.5$ days.

12. Activity A of a radioactive element is defined as its disintegration rate, *i.e.*,

$$A = -(dN/dt)$$

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

$$-\frac{dN}{dt} = \lambda N_0 e^{-\lambda t} = \lambda N$$

$\therefore$ $A = \lambda N$

Hence, $\frac{A}{A_0} = \frac{\lambda N}{\lambda N_0} = \frac{N}{N_0}$

Fraction value period t_f is the time after which the number of mother nuclei left is a fraction f times that at start. Then, after a lapse of time $t\ (= n_f\, t_f)$ the number of surviving mother nuclei is given by:

$$\frac{N}{N_0} = (f)^{n_f} \quad \text{or} \quad \frac{A}{A_0} = (f)^{n_f}$$

Here, $A_0 = I_0$ and $t_f = 9$ years

$t = 9 + 9 = 18$ years

$$n_f = \frac{t}{t_f} = \frac{18}{9} = 2$$

Now, $f = (1/3)$

$\therefore$ $\frac{A}{I_0} = \left(\frac{1}{3}\right)^2 = \frac{1}{9}$ or $A = \frac{I_0}{9}$.

13. After a lapse of time t, let the number of atoms of X element and Y element be respectively n_X and n_Y.

Then, $\frac{n_Y}{n_X} = 7$ or $\frac{n_Y}{n_X} + 1 = 7 + 1$

or $\frac{n_Y + n_X}{n_X} = 8$

or $\frac{n_X}{n_Y + n_X} = \frac{1}{8}$

Death of an atom of mother element means the birth of an atom of daughter element.

$\therefore \quad \frac{n_X}{n_Y + n_X} = \frac{N}{N_0} = \frac{1}{8} = \left(\frac{1}{2}\right)^n$

$\therefore \quad n = 3 = \frac{t}{T}$

But, $T = 2$ hours, hence $t = 6$ hours.

14. Half-value period = 3 hours

$= 3 \times 60$ minute $= 180$ minute

Approximate mean disintegration rate

$= \frac{100 + 50}{2} = 75$ disintegration/minute

$\therefore$ Total count in first half-value period

$= 75 \times 180 \cong 13500$

Total number of disintegrations is slightly greater than 13500.

Hence, the answer is 3 hours and 14100 (approx.).

15. $A_1 = N_1\lambda, \quad A_2 = N_2\lambda$

Mean life, $T = \frac{1}{\lambda}$

$A_1 - A_2 = (N_1 - N_2)\lambda = (N_1 - N_2)\frac{1}{T}$

So, number of atoms disintegrated in $(t_2 - t_1)$ sec

$= (N_1 - N_2) = (A_1 - A_2)T$.

16. $\lambda = \frac{h}{\sqrt{2mE}} = \frac{h}{\sqrt{2m_\alpha Q_\alpha V}}$

On putting $Q_\alpha = 2 \times 1.6 \times 10^{-19}\,C$

$m_\alpha = 4m_p = 4 \times 1.67 \times 10^{-27}\,\text{kg} \Rightarrow \lambda = \frac{0.101}{\sqrt{V}}\,\text{Å}$

17. Stopping potential is that negative potential for which photo electric current is zero.

18. $\lambda_0 = \frac{c}{\nu_0} = \frac{3 \times 10^8}{5 \times 10^{14}} = 6 \times 10^{-7}\,\text{m} = 6000\,\text{Å}$

19. *Ga* has a valancy of 3.

20. Aluminum is trivalent impurity.