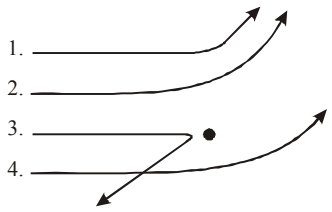
26

ATOMS

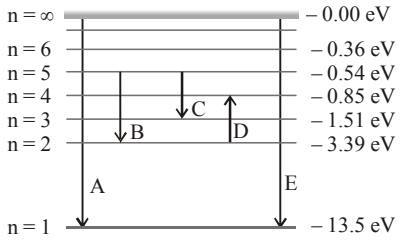
Diagram Based Questions :

1. The diagram shows the path of four α-particles of the same energy being scattered by the nucleus of an atom simulateneously which of those is not physically possible?



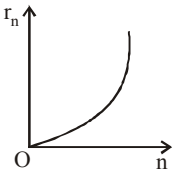
(a) 3 and 4 (b) 2 and 3
(c) 1 and 4 (d) 4 only

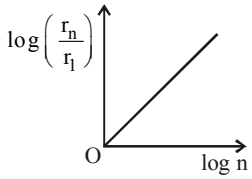
2. The energy levels of the hydrogen spectrum is shown in figure. There are some transitions A, B, C, D and E. Transition A, B and C respectively represent

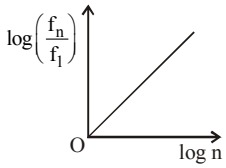


(a) first member of Lyman series, third spectral line of Balmer series and the second spectral line of Paschen series
(b) ionization potential of hydrogen, second spectral line of Balmer series, third spectral line of Paschen series
(c) series limit of Lyman series, third spectral line of Balmer series and second spectral line of Paschen series
(d) series limit of Lyman series, second spectral line of Balmer series and third spectral line of Paschen series

3. If in hydrogen atom, radius of n^{th} Bohr orbit is r_n, frequency of revolution of electron in n^{th} orbit is f_n, choose the correct option.

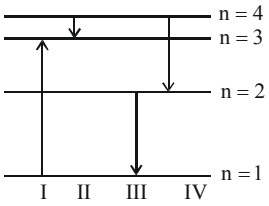
(a)


(b)


(c)


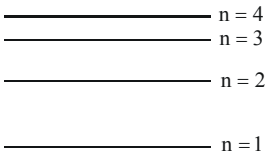
(d) Both (a) and (b)

4. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy?



(a) 4 (b) 3
(c) 2 (d) 1

5. Four lowest energy levels of H-atom are shown in the figure. The number of possible emission lines would be



(a) 3 (b) 4
(c) 5 (d) 6

Solution

1. **(d)** α-particle cannot be attracted by the nucleus.

2. **(c)** Transition A (n = ∞ to 1) : Series line of Lyman series
Transition B (n = 5 to n = 2) : Third spectral line of Balmer series
Transition C (n = 5 to n = 3) : Second spectral line of Paschen series

3. **(d)** Radius of n^{th} orbit $r_n \propto n^2$, graph between r_n and n is a parabola. Also,

$$\frac{r_n}{r_1} = \left(\frac{n}{1}\right)^2 \Rightarrow \log_e\left(\frac{r_n}{r_1}\right) = 2\log_e(n)$$

Comparing this equation with y = mx + c,

Graph between $\log_e\left(\frac{r_n}{r_1}\right)$ and $\log_e$ (n) will be a straight line, passing from origin.
Similarly it can be proved that graph between $\log_e\left(\frac{f_n}{f_1}\right)$ and $\log_e$ n is a straight line. But with negative slops.

4. **(b)**

5. **(d)** Number of possible emission lines

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