Spectral Lines in Hydrogen Series

https://gemini.google.com/app/17c9f79013c972a8

Response: **Step 1: Determine the highest energy level ($n_{\max}$)**

Spectral lines in a series correspond to transitions terminating at a specific lower principal quantum number n_f:

- **Lyman series:** $n_f = 1$
- **Balmer series:** $n_f = 2$
- **Paschen series:** $n_f = 3$
- **Brackett series:** $n_f = 4$

For the **Balmer series** ($n_f = 2$), the number of observed lines is given by:

$$\text{Number of lines} = n_{\max} - n_f$$

Given that there are 5 lines in the Balmer series:

$$5 = n_{\max} - 2 \implies n_{\max} = 7$$

Thus, the highest excited state electrons are de-exciting from is $n = 7$.

Step 2: Calculate lines for Lyman, Paschen, and Brackett series

Using $n_{\max} = 7$ for each series ($n_{\max} - n_f$):

- **Lyman series** ($n_f = 1$):

$$\text{Lines} = 7 - 1 = 6$$

- **Paschen series** ($n_f = 3$):

$$\text{Lines} = 7 - 3 = 4$$

- **Brackett series** ($n_f = 4$):

$$\text{Lines} = 7 - 4 = 3$$

Conclusion

The number of lines in the Lyman, Paschen, and Brackett series in order are **6, 4, 3**.

Correct Option: (1)