(2)

A. If the partitioning is even, then the recurrence relation governing complexity will be given by

$$T(n) = (n-1) + 2T\left(\frac{n}{2}\right)$$

$$\cancel{\le (n-1) + 2\left[2T\left(\frac{n}{4}\right) + \left(\frac{n}{2}-1\right)\right]}$$

$$\cancel{= (n-1) + 2^2 T\left(\frac{n}{4}\right) +}$$

$$\le n + 2T\left(\frac{n}{2}\right)$$

$$\le n + 2\left[2T\left(\frac{n}{4}\right) + \frac{n}{2}\right]$$

$$\le n + 2^2 T\left(\frac{n}{4}\right) + n$$

$$= 2^2 T\left(\frac{n}{4}\right) + n + n$$

$$= 2^2\left[2T\left(\frac{n}{8}\right) + \frac{n}{4}\right] + n + n$$

$$= 2^3 T\left(\frac{n}{8}\right) + n + n + n$$

$$\vdots$$

after $k-1$ steps

$$= 2^{k-1} T\left(\frac{n}{2^{k-1}}\right) + \underbrace{n + n + \cdots + n}_{k-1}$$

$$= 2^{k-1} T\left(\frac{2^k}{2^{k-1}}\right) + (k-1)n$$

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

$$= \frac{n}{2} \cdot 1 + (k-1)n = kn - \frac{n}{2}$$

$$= n\log n - \frac{n}{2}$$

Assume n is a power of 2 i.e, $n = 2^k$ for some k.

$$T\left(\frac{n}{2}\right) = 2T\left(\frac{n}{4}\right) + \left(\frac{n}{2} - 1\right)$$

$$\le 2T\left(\frac{n}{4}\right) + \frac{n}{2}$$

$$T\left(\frac{n}{4}\right) \le 2T\left(\frac{n}{8}\right) + \frac{n}{4}$$