(10)

$$= 2^{2^{k+2}} + 2 \cdot 2^{2^{k+1}} + 1 - 2^{2^{k+1}} = 2^{2^{k+2}} + 2^{2^{k+1}} + 1$$

$$E = 2^{2^{k+2}} + 2^{2^{k+1}} = 2^{2^{k+1}} \left(2^{2^{k+2} - 2^{k+1}} + 1 \right)$$

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

$$2^{2^{k+1}} + 2^{2^{k+1}} + 1 \geq 10^{1000}$$

$$2 \cdot 2^{2^{k+1}} + 1 \geq 10^{1000} \quad \left[2 \cdot 2^{2^{k+1}} + 1 > 2 \cdot 2^{2^{k+1}} \geq 10^{1000} \right]$$

$$2 \cdot 2^{2^{k+1}} \geq 10^{1000}$$

$$\log \left(2^{2^{k+1}+1} \right) \geq 1000$$

$$\left(2^{k+1} + 1 \right) \geq \frac{1000}{\log 2}$$

$$2^{k+1} \geq \frac{1000}{\log 2} - 1$$

$$2^{k+1} \geq 3321$$

$$2^{10} = 1024$$

$$2^{11} = 2048$$

$$2^{12} = 4096 \Rightarrow k = 11$$

Answer: C