Heisenberg's Uncertainty principle, Illustration - Gamma ray microscope

QA:

1. Heisenberg's principle for energy-time:
   $\Delta E\, \Delta t \geq \hbar/2$

   Where: ΔE is the uncertainty in energy,

   Δt is the lifetime of the excited state

   $\hbar = h/2\pi$ is the reduced Planck's constant

   Energy of a photon is given by: $E = hc/\lambda$,
   Differentiating both sides: $\Delta E = |dE/d\lambda| = \frac{hc\Delta\lambda}{\lambda^2}$
   Therefore, $\Delta\lambda = \frac{\lambda^2 \Delta E}{hc}$, also $\Delta E \geq \frac{\hbar}{2\Delta t}$ combining both,

$$\Delta\lambda \geq \frac{\lambda^2}{hc}\frac{\hbar}{2\Delta t}$$

Given: $\Delta t = 10\text{ns}$, $\lambda = 500\text{ nm} = 500\times10^{-9}\text{ m}$
Hence, $\Delta\lambda = 6.63\text{fm}$