53. (a) The length of the pulse's wave train is given by $L = c\Delta t = (2.998 \times 10^8\,\text{m/s})(10 \times 10^{-15}\,\text{s}) = 3.0 \times 10^{-6}\,\text{m}$. Thus, the number of wavelengths contained in the pulse is

$$N = \frac{L}{\lambda} = \frac{3.0 \times 10^{-6}\,\text{m}}{500 \times 10^{-9}\,\text{m}} = 6.0 \ .$$

(b) We solve for X from $10\,\text{fm}/1\,\text{m} = 1\,\text{s}/X$:

$$X = \frac{(1\,\text{s})(1\,\text{m})}{10 \times 10^{-15}\,\text{m}} = \frac{1\,\text{s}}{(10 \times 10^{-15})(3.15 \times 10^7\,\text{s/y})} = 3.2 \times 10^6\text{y} \ .$$