1. Total E conserved
Initial KE = 0, final KE > 0
some rest energy was converted to KE. So $\boxed{2m < M}$

2\. a. $L' = L_0 = 10\ m$

$L = L'/\gamma = 6\ m$

$ct = cL/v = 7.5\ m$

so $\boxed{x_2 = 0,\ ct_2 = 7.5}$

b. $\boxed{x_2' = -10,\ ct_2' = 12.5}$

c. $\Delta s^2 = 7.5^2 = 56.25$

$\Delta s'^2 = 12.5^2 - 10^2 = 56.25$

$\Delta s'^2 = \Delta s^2$ (always true)

3\. $E_i = 2E_\gamma$

$p_{xi} = E_\gamma/c \cos(60°) + E_\gamma/c \cos(60°)$

$= E_\gamma/c$

$p_{yi} = 0$

$\boxed{E_f = 2E_\gamma,\ p_f = [E_\gamma/c, 0]}$

$Mc^2 = \sqrt{(2E_\gamma)^2 - (p_f c)^2} = \sqrt{3E_\gamma^2}$

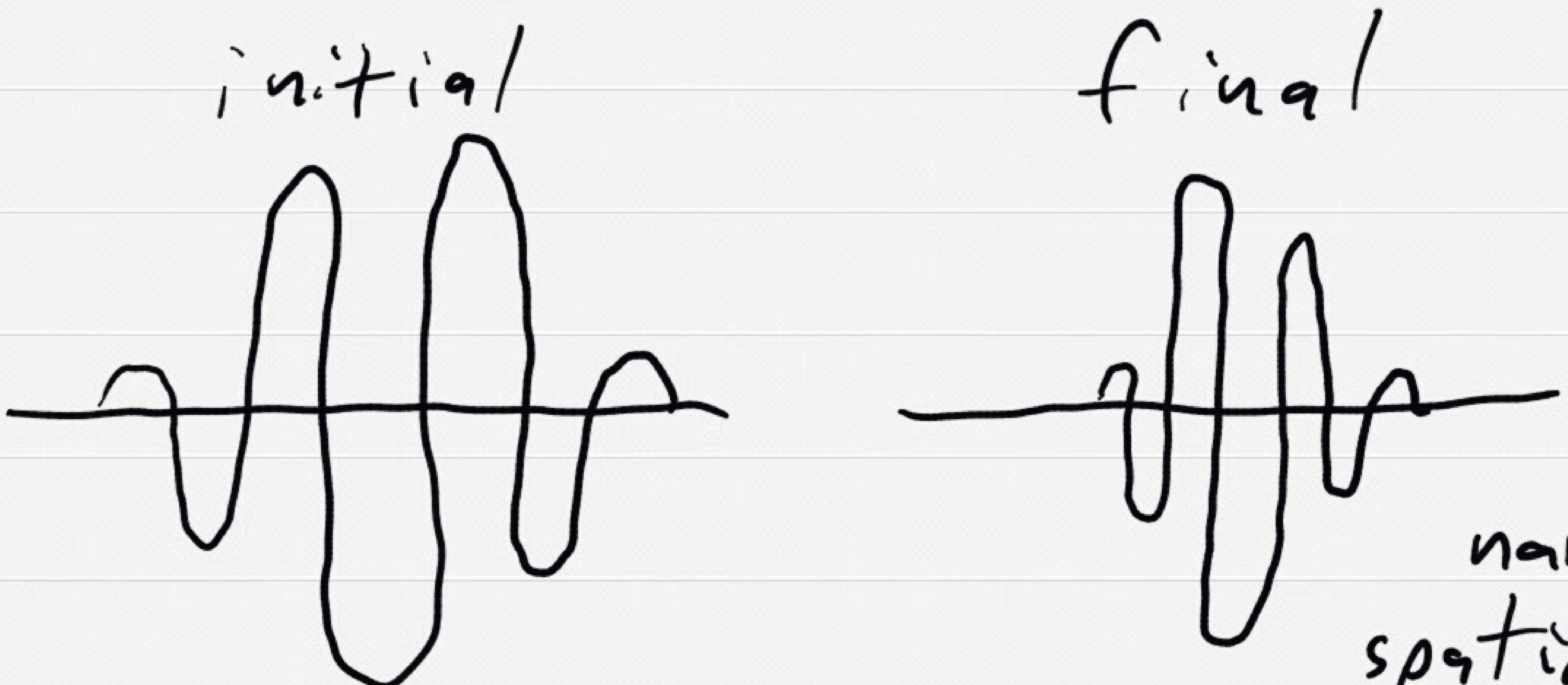
$\Rightarrow \boxed{M = \sqrt{3}E_\gamma/c^2}$

4. Faster electrons
⇒ more momentum
⇒ smaller wavelength
⇒ **decreased spacing**

5. a. $\Delta\nu = \Delta E / h$
$= \boxed{250{,}000\ e / h}$

6. $\Delta\lambda = .0024\ nm\ (1 - \cos\theta)$
$\lambda_i = 0.0024\ nm$
$\Rightarrow E_i = hc/\lambda_i = 1200/0.0024$
$= 500{,}000\ eV$
$E_f = 250{,}000\ eV$
$\Rightarrow \lambda_f = .0048\ nm$
$\Delta\lambda = 0.0024\ nm \Rightarrow \cos\theta = 0$
$\Rightarrow \boxed{\theta = 90°}$

6. $\Delta E\,\Delta t \sim \hbar \sim 10^{-15}\ eV\ s$
$\Delta t \sim 10^{-15} / (2 \cdot 500000)$
$= \boxed{10^{-21}\ s}$

7.


2X narrower spatial extent