Part 2

$x_2 - x_3 = 6k_1$, where $k_1 \in \mathbb{Z}$

want: $x_2^2 - x^2 = 6k_2$ for some $k_2 \in \mathbb{Z}$

$\Leftrightarrow$

$x_2 - x_3 = 6k_1$

$x_2^2 - x_2 x_3 = 6k_1 x_2$

$x_2^2 x_3 - x_2 x_3^2 = 6k_1 x_2 x_3$

$x_2 - x_3 = 6k_1$

$\Rightarrow (x_2 - x_3)(x_2 + x_3) = 6k_1(x_2 + x_3)$

$\Leftrightarrow x_2^2 - x_3^2 = 6k_1(x_2 + x_3)$

recall: $x_2, x_3 \in W = \{0, 1, 2, \ldots\} \subseteq \mathbb{Z}$

so, $x_2 + x_3 \in \mathbb{Z}$ (by closure)

since $k_1 \in \mathbb{Z}$, and $x_2 + x_3 \in \mathbb{Z}$, then $k_1(x_2 + x_3) \in \mathbb{Z}$ by closure property of $(*)$ on $\mathbb{Z}$.

let $k_2 = k_1(x_2 + x_3) \in \mathbb{Z}$

so, $x_2^2 - x_3^2 = 6k_2$ ✓

so, $\langle x_2^2, x_3^2 \rangle \in \sim$

thus $[x_2^2]_\sim = [x_3^2]_\sim$ by Lemma 3N.

therefore, $x = y$. $\square$