The maximum height (minimum y-value) of the cannonball is:

$$k = cannon.y + ballvy + (ballvy + 0.1) + (ballvy + 0.2) + \cdots + (-0.1)$$

$$= cannon.y + \frac{(ballvy - 0.1)(-10 \cdot ballvy)}{2}$$

$$= cannon.y - 5(ballvy)(ballvy - 0.1)$$

Which means the ball travels $5(ballvy)(ballvy - 0.1)$ pixels up from its starting position to its peak.

Thus, $dy = 5(ballvy)(ballvy - 0.1)$

Divide both sides by 5 and square root BS, taking the negative to get $ballvy \approx -\sqrt{\frac{dy}{5}}$

We want the ball to go slightly higher than the player, so let $dy = cannon.y - player.y + 125$

Thus, we set $ballvy = -\sqrt{\frac{cannon.y - player.y + 125}{5}} \Longrightarrow dy = 5(ballvy)(ballvy - 0.1)$

Now, the let equation for the path of the ball be $y = a(x-h)^2 + k$

$$\therefore\ y = a(x - h)^2 + cannon.y - dy$$

The points (cannon.x, cannon.y) and (player.x, player.y) must be on the parabola.

Sub in (cannon.x, cannon.y)

$$cannon.y = a(cannon.x - h)^2 + cannon.y - dy$$

$$\therefore\ a = \frac{dy}{(cannon.x - h)^2}$$

Sub in (player.x, player.y) and $a = \frac{dy}{(cannon.x - h)^2}$

$$player.y = \frac{dy}{(cannon.x - h)^2}(player.x - h)^2 + cannon.y - dy$$

$$0 = dy\,(player.x^2 - 2 \cdot player.x \cdot h + h^2) + (cannon.y - dy - player.y)\,(cannon.x^2 - 2 \cdot cannon.x \cdot h + h^2)$$

If we expand RHS:

- The coefficient on h^2 is $dy + cannon.y - dy - player.y = cannon.y - player.y$
- The coefficient on h is $-2 \cdot player.x \cdot dy - 2 \cdot cannon.x \cdot (cannon.y - dy - player.y)$
- The constant is $player.x^2 \cdot dy + cannon.x^2 \cdot (cannon.y - dy - player.y)$

We can then use the quadratic formula to solve for h $(= cannon.ballapex)$, and then find $ballvx$