The height $h(t)$ of a baseball, in meters, at time t seconds after it is tossed out of a window is modelled by the function $h(t) = -5t^2 + 20t + 15$. A boy shoots at the baseball with a paintball gun. The trajectory of the paintball is given by the function $g(t) = 3t + 3$.

a. Will the paintball hit the baseball? If so, when? At what height will the baseball be?

b. Determine the domain and range.

a. Determine when $h(t) = g(t)$

$$-5t^2 + 20t + 15 = 3t + 3$$
$$\quad -3t \; -3 \quad -3t - 3$$

$$-5t^2 + 17t + 12 = 0$$

Quadratic formula! But I'm going to.

factor!

$$\left.\begin{array}{l} a \times c = -60 \\ b = +17 \end{array}\right\} \begin{array}{l} +20 \times -3 = -60 \\ +20 - 3 = 17 \end{array}$$

$$-5t^2 + 20t - 3t + 12 = 0$$
$$-5t(t-4) - 3(t-4) = 0$$
$$\underbrace{(-5t-3)}\underbrace{(t-4)} = 0$$

$t = \frac{-3}{5}$ $\quad t = 4$

$= -0.6s$

$\therefore$ they will collide after 4 seconds

a) continued

height at 4s

Use $h(t)$, $g(t)$

$$h(4) = -5(4)^2 + 20(4) + 15$$
$$= -80 + 80 + 15$$
$$= 15$$

$\therefore$ 15m high

$$g(4) = 3(4) + 3$$
$$= 15$$

$\therefore$ 15m high

$$\left.\begin{aligned} &-5(4)^2 + 17(4) + 12 \\ &= -80 + 68 + 12 \end{aligned}\right\} \text{using new equation}$$
$$= 0$$

verifies that this is the point they meet!

Remember, this is a "zero" of our new function

b) baseball

$\{t \in \mathbb{R} \mid 0 \leq t \leq 4\}$ until collision

$\{h(t) \in \mathbb{R} \mid 15 \leq h(t) \leq 35\}$

assuming we don't care about the ball getting back to the ground.

*I need to know how high the ball goes!

paintball

$\{t \in \mathbb{R} \mid 0 \leq t \leq 4\}$ until collision

$\{g(t) \in \mathbb{R} \mid 3 \leq g(t) \leq 15\}$

assuming we don't care about ball falling back to the ground

height at collision

- both domains & range are just for the time from 0 until collision

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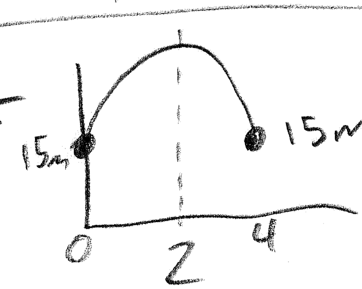
*



max height of baseball

$$h(2) = -5(2)^2 + 20(2) + 15$$

$$= -9 + 40 + 15$$

$$\boxed{= 35}$$