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Finding points of Intersection between Parametric and Cartesian Equations

A curve C has parametric equations $x = \frac{t}{1-t}$, $y = \frac{1+t}{t}$ where $t \in \mathbb{R}, t \neq 0, 1$

Find the points where the line $y = 2x + 1$ intersects the curve C.

Method: Substitute the parametric equations into $y = 2x + 1$ to find t.

$\therefore \frac{1+t}{t} = \frac{2t}{1-t} + 1$

$\therefore (1+t)(1-t) = 2t^2 + t(1-t)$

$\therefore 1 - t^2 = 2t^2 + t - t^2$

$\therefore 2t^2 + t - 1 = 0$

$\therefore (2t-1)(t+1) = 0$

$\therefore t = \frac{1}{2}$ or $t = -1$

when $t = \frac{1}{2}$,

$x = 1$, $y = 3$

when $t = -1$,

$x = -\frac{1}{2}$, $y = 0$

$\therefore$ points of intersection are $(1, 3)$ and $(-\frac{1}{2}, 0)$

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