Hyperbola.

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

$$x = a\cosh t$$
$$y = b\sinh t$$

$$\frac{dy}{dx} = \frac{b}{a \cdot \tanh(t)}$$

$$\frac{y - b \cdot \sinh t}{x - a \cdot \cosh t} = \frac{b}{a \tanh(t)}$$

$$\frac{0 - b \cdot \sinh t}{x - a \cdot \cosh t} = \frac{b}{a \cdot \tanh t}$$

$$\cancel{-a \cdot \tanh t = x - a \cdot \cosh t}$$

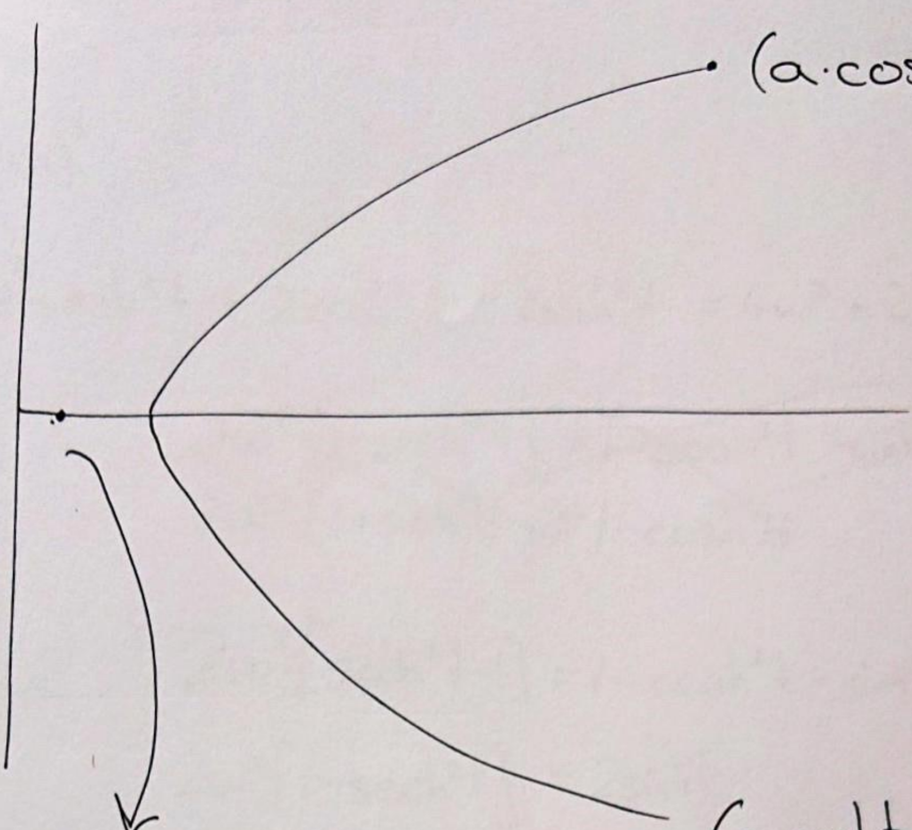
$$-a \cdot \sinh t \tanh t = x - a \cdot \cosh t$$

$$x = a[\cosh t - \sinh t \tanh t]$$

$$x = a \cdot \cosh t [1 - \tanh^2 t]$$

$$x = a \cdot \cosh t [\operatorname{sech}^2 x]$$

$$x = a \operatorname{sech} t.$$



$$num(x) = a\cdot\cosh t(1-u)^2 + 2a\omega\,\operatorname{sech} t(1-u)u + a\cosh t(u)^2$$
$$num(y) = -b\sinh t(1-u)^2 + 0 + b\sinh t(u)^2$$

$$[num(x)]^2 - [num(y)]^2 = 1$$

$$u^2[1-u]^2 : LHS: 4\omega^2\operatorname{sech}^2 t + 2\cosh^2 t + 2\sinh^2 t = 4\omega^2 + 2$$

$$2\omega^2[1+\operatorname{sech}^2 t] = \cosh^2 t + \sinh^2 t + 1$$

$$2\omega^2[1+\operatorname{sech}^2 t] = \cosh 2t + 1$$

$$2\omega^2[1+\operatorname{sech}^2 t] = 2\cosh^2 t$$

$$\omega^2[1+\operatorname{sech}^2 t] = \cosh^2 t$$

$u^2(1-u)^2$

$$4w^2 \operatorname{sech}^2 t + 2\cosh^2 t + 2\sinh^2 t = 4w^2 + 2$$

$$\cancel{2w^2[1+\operatorname{sech}^2 t] = 1-\cosh^2 t - \sinh t^2}$$

$$\cancel{2w^2[1+\operatorname{sech}^2 t]} = 1-\cosh 2t$$

$$2w^2[\operatorname{sech}^2 t - 1] = 1-\cosh^2 t - \sinh t^2$$

$$2w^2[1-\operatorname{sech}^2 t] = 2\sinh^2 t$$

$$w^2 = \frac{\sinh^2 t}{1-\operatorname{sech}^2 t}$$

$$w^2 = \frac{\sinh^2 t \cdot \cosh^2 t}{\cosh^2 t - 1}$$

$$w^2 = \frac{\sinh^2 t \cdot \cosh^2 t}{\sinh^2 t}$$

$$\boxed{w = \cosh t.}$$

Hyperbola -2

$$\frac{y-b\cdot\sinh t}{x-a\cdot\cosh t}=\frac{b}{a\tanh(t)}$$

$$\frac{y-b\cdot\sinh t}{a-a\cdot\cosh t}=\frac{b}{a\tanh(t)}$$

$$(y-b\cdot\sinh t)\tanh(t)=b[1-\cosh t)$$

$$y=b[1-\cosh t+\sinh t\tanh t]$$

$$y=b[1-\cosh t[1\cancel{+}\tanh^2 t]$$

$$y=b[1-\cosh t\,\operatorname{sech}^2 t$$

$$y=b\frac{[1-\operatorname{sech} t]}{\tanh}$$

$$\frac{\cosh-1}{\sinh}$$

$$\frac{1-\frac{1}{\cosh}}{\tanh}\qquad\frac{\frac{\cosh-1}{\cosh}}{\tanh}\qquad\frac{\frac{\cosh-1}{\cosh}}{\frac{\sinh}{\cosh}}$$

$$\mathrm{num}(x) = a(1-u)^2 + 2a\,\omega(1-u)u + a \cdot \cosh t\,(u)^2$$
$$\mathrm{num}(y) = 0 + 2b[1-\operatorname{sech} t]\,\omega(1-u)u + b\sinh t\,(u)^2$$

$$[\mathrm{num}(x)]^2 - [\mathrm{num}(y)]^2 = 1$$

LHS: $\dfrac{4a^2\omega^2 + 2a^2\cosh t}{a^2}$

~~RHS~~ $\dfrac{-4b^2\omega^2[1-\operatorname{sech} t]^2}{b^2}$

RHS: $4\omega^2 + 2$

$\therefore$

$\cancel{4\omega^2 + 2\cosh t - 4\omega^2 + 4s}$

$$4\omega^2 + 2\cosh t - 4\omega^2[1-\operatorname{sech} t]^2 = 4\omega^2 + 2$$

$$2[\cosh t - 1] = 4\omega^2[1-\operatorname{sech} t]^2$$

$$\omega^2 = \frac{\cosh t - 1}{2[1-\operatorname{sech} t]^2} \quad (\tanh)^2$$

$\cosh 2x - 1 =$

$$\frac{2\sinh^2 x}{2\sinh x \cosh x}$$

$$\tanh\left(\frac{x}{2}\right)$$

$$4a^2\omega^2 + 2a^2\cosh t \quad - 4b^2\omega^2 \tanh\left(\frac{t}{2}\right)^2 = 4\omega^2 + 2$$

$$2\left[\cosh t - 1\right] = 4\omega^2 \tanh^2\left(\frac{t}{2}\right)$$

$$4\sinh^2\left(\frac{t}{2}\right) = 4\omega^2 \tanh$$

$$\omega = \cosh\left(\frac{t}{2}\right)$$