Write down an integral whose value is equal to the arclength of the curve given in parametric equations by

$$y = t - \frac{1}{t}$$

$$x = t + \frac{1}{t}$$

for $1 \leq t \leq 2$.

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2/9/25

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$$ds = \sqrt{dx^2 + dy^2}$$

$$\frac{dx}{dt} = 1 - \frac{1}{t^2}, \quad \frac{dy}{dt} = 1 + \frac{1}{t^2}$$

$$= \frac{t^2 - 1}{t^2} \qquad = \frac{t^2 + 1}{t^2}$$

$$\Rightarrow ds = \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt$$

$$= \sqrt{1 - \frac{2}{t^2} + \frac{1}{t^4} + 1 + \frac{2}{t^2} + \frac{1}{t^4}}\, dt$$

$$= \sqrt{2 + \frac{2}{t^4}}\, dt$$

$$\int \frac{ds}{dt}\, dt = \int_1^2 \sqrt{2 + \frac{2}{t^4}}\, dt$$

$$S = \sqrt{2} \int_1^2 \sqrt{\frac{t^4 + 1}{t^4}}\, dt$$