

find SA about y-axis for  
 $x = t^2$        $y = t^3$       from  $1 \leq t \leq 2$

$$x' = 2t \quad y' = 3t^2$$

$$\int_1^2 2\pi x \, ds$$

$$ds = \sqrt{(2t)^2 + (3t^2)^2} = \sqrt{4t^2 + 9t^4}$$

$$SA = \int_1^2 2\pi t^2 \sqrt{4t^2 + 9t^4} \, dt = \int_1^2 2\pi t^2 \sqrt{t^2(4 + 9t^2)}$$

$$= \int_1^2 2\pi t^2 \cdot \underline{t} \sqrt{4 + 9t^2} \, \underline{dt}$$

$$u = 4 + 9t^2$$

$$du = 18 + dt$$

$$\frac{1}{18} du = t \, dt$$

$$= \int_{13}^{40} 2\pi \frac{u-4}{9} \frac{1}{18} \sqrt{u} \, du$$

$$\frac{u-4}{9} = t^2$$

$$= \frac{\pi}{81} \int_{13}^{40} (u-4) \sqrt{u} \, du = \frac{\pi}{81} \int_{13}^{40} u^{3/2} - 4u^{1/2} \, du$$

$$= \frac{\pi}{81} \left[ \frac{2}{5} u^{5/2} - 4u^{3/2} \cdot \frac{2}{3} \right]_{13}^{40}$$

$$= \frac{\pi}{81} \left[ \frac{2}{5} (40)^{5/2} - \frac{8}{3} (40)^{3/2} - \left( \frac{2}{5} 13^{5/2} - \frac{8}{3} (13)^{3/2} \right) \right]$$