

$$10. \vec{r}(t) = \underbrace{t^2}_{x(t)} \vec{i} + \underbrace{3t}_{y(t)} \vec{j} \quad \rho(x,y) = 2y \quad 0 \leq t \leq 1$$

$$\text{mass} = \int_0^1 (6t) \sqrt{4t^2 + 9} \, dt$$

$$u = \underline{4t^2 + 9} \quad du = \underline{8t} \, \underline{dt}$$

$$m = 6 \cdot \frac{1}{8} \int_0^1 \underline{8t} (4t^2 + 9)^{\frac{1}{2}} \underline{dt}$$

$$= \frac{3}{4} \int_{t=0}^{t=1} u^{\frac{1}{2}} \, du$$

$$= \frac{3}{4} \cdot \left[\frac{2}{3} u^{\frac{3}{2}} \right]_{t=0}^{t=1}$$

$$= \frac{3}{4} \cdot \frac{2}{3} \left[(4t^2 + 9)^{\frac{3}{2}} \right]_{t=0}^{t=1}$$

$$= \frac{1}{2} \left[13^{\frac{3}{2}} - 9^{\frac{3}{2}} \right]$$

$$= \frac{1}{2} \left[\sqrt{13^3} - \sqrt{9^3} \right]$$

$$= \frac{1}{2} \left[13\sqrt{13} - 9\sqrt{9} \right]$$

$$= \frac{1}{2} \left[13\sqrt{13} - 27 \right]$$

$$\rho(x,y) = 2y$$

$$\rho(x(t), y(t)) = 2(3t) \\ = 6t$$

$$\vec{r}'(t) = 2t \vec{i} + 3 \vec{j}$$

$$\|\vec{r}'\| = \sqrt{(2t)^2 + 3^2} \\ = \sqrt{4t^2 + 9}$$