10.1

9. $x = -\sqrt{t+1} \quad y = \sqrt{3t}$

$$\frac{dy}{dx} = \frac{\cancel{\frac{1}{2}}(3t)^{-\frac{1}{2}} \cdot 3}{-\cancel{\frac{1}{2}}(t+1)^{-\frac{1}{2}}}$$

$$= \frac{-3(t+1)^{\frac{1}{2}}}{(3t)^{\frac{1}{2}}}$$

$$\frac{d^2y}{dx^2} = \frac{\dfrac{(3t)^{\frac{1}{2}}\left(-\frac{3}{2}(t+1)^{-\frac{1}{2}}\right) - \left(-3(t+1)^{\frac{1}{2}}\,\frac{1}{2}(3t)^{-\frac{1}{2}}\cdot 3\right)}{\left((3t)^{\cancel{\frac{1}{2}}}\right)^{\cancel{2}}}}{-\frac{1}{2}(t+1)^{-\frac{1}{2}}}$$

$$\frac{\left(\dfrac{-3(3t)^{\frac{1}{2}}}{2(t+1)^{\frac{1}{2}}} + \dfrac{9(t+1)^{\frac{1}{2}}}{2(3t)^{\frac{1}{2}}}\right)\cdot\dfrac{1}{3t}\cdot -2(t+1)^{\frac{1}{2}}}{\cancel{3t}}$$

$$\frac{-\cancel{1}}{\cancel{2(t+1)^{\frac{1}{2}}}}$$

$$\frac{3^{\frac{3}{2}}}{3^{\frac{3}{2}}}\frac{(3t)^{\frac{1}{2}}t^{\frac{1}{2}}}{t \cdot t^{\frac{1}{2}}} - \frac{3(t+1)}{(3t)^{\frac{3}{2}}}$$

$$3^{\frac{3}{2}}t^{\frac{3}{2}}$$

$$\frac{3^2 t \quad -3(t+1)}{(3t)^{\frac{3}{2}}}$$

$$\frac{6t-3}{(3t)^{\frac{3}{2}}}$$

43.

$x = 3t - 2\sin t \qquad y = 3 - 2\cos t$

$$\text{Curve Length} = \int_0^{2\pi} \sqrt{(3-2\cos t)^2 + (2\sin t)^2}$$

$$\int_0^{2\pi} \sqrt{9 - 12\cos t + 4\cos^2 t + 4\sin^2 t}\, dt$$

$$\int_0^{2\pi} \sqrt{9 - 12\cos t + 4(\cos^2 t + \sin^2 t)}\, dt$$

$$\int_0^{2\pi} \sqrt{13 - 12\cos t}\, dt$$

15.

$$x = \ln(2t) \qquad y = \ln(3t)^4$$

$$y = 4\ln(3t)$$

$$\frac{dy}{dx} = \frac{4\left(\frac{1}{\cancel{3t}}\right)\cdot\cancel{3}}{\frac{1}{\cancel{2t}}\cdot\cancel{2}} = 4$$

$$\frac{d^2y}{dx^2} = \frac{0}{\frac{1}{t}} = 0$$

33.

$$x = \frac{1}{3}t^3 \qquad y = \frac{1}{2}t^2 \qquad 0 \le t \le 1$$

$$\text{Curve Length} = \int_a^b \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt$$

$$= \int_0^1 \sqrt{(t^2)^2 + (t)^2}\, dt$$

$$\int_0^1 \sqrt{t^4 + t^2}\, dt$$

$$\sqrt{t^2(t^2+1)}\, dt$$

$$\sqrt{100}$$

$$\sqrt{25 \cdot 4}$$

$$= \int_0^1 t\sqrt{t^2+1}\, dt$$

$$u = t^2+1$$

$$\frac{du}{2t} = 2t\,dt$$

$$= \int \cancel{t}\, u^{\frac{1}{2}} \cdot \frac{du}{2\cancel{t}}$$

$$\frac{1}{2}\int u^{\frac{1}{2}}\, du$$

$$\frac{1}{\cancel{2}}\left(\frac{\cancel{2}}{3} \cdot u^{\frac{3}{2}}\right)$$

$$\frac{1}{3}(t^2+1)^{\frac{3}{2}}\Big|_0^1 =$$

$$\sqrt{2^3}$$

$$\sqrt{8}$$

$$2\sqrt{2}$$

$$\frac{1}{3}(2)^{\frac{3}{2}} - \frac{1}{3}$$

$$\frac{2\sqrt{2}-1}{3}$$

10.2

11.   11. 4, 180°

$\langle -1, 0 \rangle$

45. $\lim_{t\to\infty} \boxed{\left\langle \frac{1-t^2}{1+t^2}, \frac{2t}{1+t^2} \right\rangle}$

$\frac{(1+t^2)(-2t)-(1-t^2)(2t)}{(1+t^2)^2}$, $\frac{(1+t^2)(2)-(2t)(2t)}{(1+t^2)^2}$

$\left\langle \frac{-2t-\cancel{2t^3}-2t+\cancel{2t^3}}{\dots}, \frac{2-2t^2}{(1+t^2)^2} \right\rangle$

$\left\langle \frac{-4t}{(1+t^2)^2}, \frac{2-2t^2}{(1+t^2)^2} \right\rangle$

$-4t=0$ $\qquad$ $2-2t^2$

$t=0$ $\qquad$ $t^2=1$

$t=1,-1$

35.

$x = \sin 4t \cos t \qquad y = \sin 2t$

$t = \frac{5\pi}{4}$

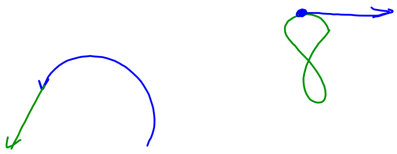
$v(t) = \langle \sin(4t)(-\sin t) + \cos t(4\cos 4t), 2\cos 2t \rangle$

$\langle 0 + -\frac{\sqrt{2}}{2}(4(-1)), 0 \rangle$

$v\left(\frac{5\pi}{4}\right) = \langle 2\sqrt{2}, 0 \rangle$

$\sqrt{(2\sqrt{2})^2 + \cancel{(0)^2}}$

$= 2\sqrt{2}$



29. $r(t) = \langle te^{-t}, e^{-t} \rangle$

$t(-e^{-t}) + e^{-t}(1) \; ; \; -e^{-t}$

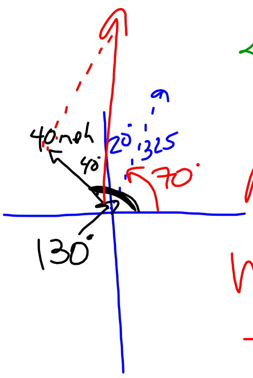
$v(t) = \langle -te^{-t} + e^{-t}, -e^{-t} \rangle$

$a(t) = (-t(-e^{-t}) + e^{-t}(-1)) + -e^{-t} \; ; \; e^{-t}$

$= \langle te^{-t} - 2e^{-t}, e^{-t} \rangle$

25. 20° E of N 325 mph

40° W of N 40 mph tail wind



$A = \langle 325 \cos 70°, 325 \sin 70° \rangle$

$\underline{+\; W = \langle 40 \cos 130°, 40 \sin 130° \rangle}$

$\langle 85.444, 336.042 \rangle$

$\sqrt{85.444^2 + 336.042^2}$

346.735 mph

$\tan^{-1}\left(\frac{336.042}{85.444}\right) = 1.321$ rad.